

U.S. Army - Corps of engineers.

ANNUAL REPORT, DEPARTMENT OF THE ARMY
Fiscal Year Ended June 30, 1960

ANNUAL REPORT OF THE
CHIEF OF ENGINEERS

U.S. ARMY
ON CIVIL WORKS ACTIVITIES

1960

IN TWO VOLUMES
Vol. 1

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1961

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 1960		2. REPORT TYPE		3. DATES COVERED 00-00-1960 to 00-00-1960	
4. TITLE AND SUBTITLE Annual Report on Civil Works Activities for Fiscal Year 1960				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers, 441 G Street NW, Washington, DC, 20314-1000				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 108	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

J
85
. E7A2

CONTENTS

Volume 1

v. 1-2
1960

Letter of Submittal.....	V
CHAPTER I. A PROGRAM FOR WATER RESOURCES DEVELOPMENT.....	
1. Scope of the Program.....	1
2. Status of Program.....	1
3. Organization.....	2
II. BENEFITS OF THE PROGRAM.....	3
1. Navigation.....	3
2. Flood Control.....	4
3. Other Benefits.....	5
4. Public Recreation Use of Project Areas.....	9
5. Fish and Wildlife.....	10
III. PROJECT CONSTRUCTION AND OPERATIONS PROGRESS.....	11
1. Navigation.....	11
2. Shore Protection.....	16
3. General Flood Control.....	16
4. Multiple-Purpose (Power) Projects.....	22
5. Hydroelectric Power Production.....	23
6. Mississippi River Flood Control.....	29
7. General Operations.....	37
IV. CURRENT PROJECT PLANNING AND DEVELOPMENT.....	39
1. Program Policy Matters.....	39
2. Omnibus River and Harbor and Flood Control Act of 1960.....	44
3. Survey Program.....	44
4. Board of Engineers for Rivers and Harbors.....	47
5. Beach Erosion Board.....	47
6. Advance Engineering and Design.....	48
7. Collection and Study of Basic Data.....	48
V. FUNDING TRENDS.....	51
1. Funds Available for Work.....	51
2. Annual Appropriations.....	54
3. Expenditures (Costs).....	55
VI. OTHER CIVIL WORKS ACTIVITIES.....	58
1. St. Lawrence Seaway.....	58
2. St. Lawrence River Joint Board of Engineers.....	58
3. Flood Fighting and Other Emergency Operations.....	59
4. Administration of Laws for Protection of Navigable Waters.....	62
5. Regulation of Hydraulic Mining, California.....	64
6. Civil Works Investigation Program.....	64
7. United States Lake Survey.....	65

CHAPTER VI. OTHER CIVIL WORKS ACTIVITIES—Continued

	Page
8. Washington, D.C., Water Supply-----	66
9. Foreign Technical Assistance-----	67
10. Publications of the Corps of Engineers-----	68
VII. ECONOMY MEASURES-----	70
Organization, Facilities and Procedures-----	70
VIII. WATERBORNE COMMERCE OF THE UNITED STATES-----	73

Volume 2

Reports on individual project operations and related civil works activities published as a separate volume.

SUBJECT: Annual Report on Civil Works Activities for Fiscal Year 1960.

TO: THE SECRETARY OF THE ARMY.

1. The water resource development program of the Corps of Engineers includes the preauthorization investigation, planning, funding, construction, maintenance, and operation of works for navigation, flood control, and multiple-purpose water resource uses authorized by law. The first volume of my report gives a summary of accomplishments, activities, and future trends. The second volume sets forth detailed fiscal, engineering, and statistical data.

2. The present active civil works program, consisting of more than 3,300 project authorizations, has a total estimated cost of about \$18.2 billion. Appropriations through fiscal year 1960 for that work total about \$9.3 billion, leaving about \$8.9 billion still required. Appropriations during the year were \$870 million, of which \$710 million (82 percent) was for construction and \$130 million (15 percent) was for operation and maintenance; the remaining \$30 million (3 percent) was for investigations, engineering studies, basic data, administration, and similar purposes.

3. Substantial progress was made on the authorized program during fiscal year 1960. Construction was initiated on 48 new projects and continued on 208 additional projects, of which 75 were either fully completed or placed in useful operation. In addition, noteworthy construction operations were carried out under the general authority for construction of small flood control projects.

4. This program continues to provide widespread and large-scale benefits at the regional and national levels. Items of major significance are:

(a) *Navigation.* Commerce on the Great Lakes during calendar year 1959 amounted to 80 billion ton-miles, and on the inland waterway system 117 billion ton-miles. These two segments of our national transportation system carried more than 15 percent of the Nation's ton-mileage of freight. Total waterborne traffic of the United States amounted to 1,052 million tons, of which 45, 18, and 37 percent was coastal, Great Lakes, and inland, respectively.

(b) *Flood Control.* Large-scale benefits have accrued to the Nation as a result of the Federal flood control program. Flood damage prevented by Corps of Engineers projects in operation is estimated to total more than \$9.7 billion through June 30, 1960, including about \$500 million during fiscal year 1960. There was no major flood disaster during the year, although flooding occurred in the Missouri, Ohio, and Rio Grande-Gulf Basins. Estimates indicate that in the Missouri Basin about \$250 million in damage was prevented, and about \$80 million in the other two basins.

(c) *Power.* The generating capacity of the 32 hydro projects (34 powerplants) now in operation, 6.6 million kilowatts, represents about 20 percent of the national hydroelectric capacity, and 3.5 percent of the total generating capacity (hydro and thermal), in the Nation. The 28 billion net kilowatt-hours of energy generated at Corps of Engineers projects represents almost the same percentages.

(d) *Water Supply.* The Corps provides about 1.5 million acre-feet of storage for water supply in 19 reservoirs serving about 40 cities. Some 4 million acre-feet of storage space is being utilized, either exclusively for irrigation, or jointly for irrigation and other purposes. Large quantities of water made available by power releases and evacuation of flood control storage improve the quantity and quality of downstream flows.

(e) *Public Use.* Both reservoirs and navigation projects furnish excellent opportunities for public recreation and make available approximately 2.6 million acres of water surface at normal pool levels and about 2.7 million acres of land area. Attendance at Corps of Engineers projects was 107 million during calendar year 1959, an increase of about 800 percent in the past ten years.

5. The investigation programs of the Corps provides a basis for sound development of the Nation's water resources and long-range planning to meet future needs. During the year 78 reports were transmitted to Congress. The River and Harbor, Flood Control, and Land Acquisition Policy Act of 1960 (Public Law 86-645), enacted shortly after the end of the fiscal year (July 14, 1960), increased basin monetary authorizations by \$882 million and authorized 120 projects having an estimated Federal cost of \$503 million.

6. The ultimate control and utilization of the Nation's water resources is essential to our economic growth. I am confident that the progress made thus far, as well as the widespread attention being given at all levels of government, will lead to a truly comprehensive development of our water resources to meet the needs of our expanding economy.

E. C. ITSCHNER
Lieutenant General, USA
Chief of Engineers

HIGHLIGHTS—CORPS OF ENGINEERS WATER RESOURCES DEVELOPMENT

Classification	Cumulative appropriations through 1960	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	Cumulative 1824 through 1949
I. APPROPRIATIONS¹ (\$ millions) (fiscal year):													
A. New Work²													
1. Navigation.....	2,972	209	190	141	135	88	42	25	31	47	48	60	1,956
2. Flood Control.....	3,684	286	278	226	212	143	91	82	148	151	173	231	1,663
2a. Flood Control, Mississippi River and Tributaries ³	1,131	52	52	45	47	37	31	37	45	46	47	52	640
3. Multiple-purpose including Power.....	3,165	215	190	126	157	211	204	207	272	278	296	240	769
4. Beach Erosion Control.....	7	1	1	-----	1	3	-----	-----	-----	1	-----	-----	-----
Subtotal, New Work.....	9,828	711	659	493	505	445	337	314	451	477	517	531	4,388
B. Other Work⁴	3,186	162	157	146	134	167	107	112	111	140	102	110	1,738
C. Total (A+B)	13,014	873	816	639	639	612	444	426	562	617	619	641	6,126
II. NAVIGATION (calendar year):													
A. Commerce (ton-miles) (billions):													
1. Coastal harbors and channels.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
2. Great Lakes harbors and channels.....	-----	-----	80	80	117	111	119	91	127	105	120	112	-----
3. Inland and intracoastal waterways.....	-----	-----	117	110	115	109	98	83	75	64	62	52	-----
Total (2+3).....	-----	-----	197	190	232	220	217	174	202	169	182	164	-----
B. Traffic (tons) (millions):													
1. Coastal harbors and channels.....	-----	-----	497	480	522	498	437	377	374	379	388	324	-----
2. Great Lakes harbors and channels.....	-----	-----	166	158	217	211	216	171	222	188	211	199	-----
3. Inland and intracoastal waterways.....	-----	-----	389	367	392	384	363	320	328	321	325	298	-----
Total.....	-----	-----	1,052	1,005	1,131	1,093	1,016	868	924	888	924	821	-----
III. FLOOD DAMAGES PREVENTED (\$ billions) (cumulative by fiscal year)	-----	9.7	9.2	9.0	8.7	8.2	7.8	7.3	6.6	6.0	5.3	4.9	4.6
IV. POWER:													
A. Installed (kw millions) (cumulative).....	-----	6.6	6.1	5.6	4.8	4.0	3.2	2.5	1.7	1.2	1.0	0.8	0.7
B. Generated (kwh billions) (fiscal year).....	-----	27.5	26.8	27.2	22.6	18.1	12.6	8.9	6.9	7.1	5.2	4.7	29.9
V. OTHER RELATED USES:													
A. Water supply and irrigation storage (cumulative) (million acre-feet).....	-----	5.5	5.5	5.2	5.0	5.0	4.9	4.2	2.7	2.0	1.0	1.0	0.8
B. Attendance (millions) (calendar year).....	-----	109	107	95	85	71	63	54	41	30	21	16	20
VI. RESERVOIR STORAGE (cumulative) (million acre-feet)	-----	162	155	153	150	144	120	115	87	74	60	57	-----

¹ Includes about \$0.5 billion expended on deferred-for-restudy, inactive, abandoned, or superseded projects.

² Advance Engineering and Design, and Construction.

³ Included in 2.

⁴ Operation and maintenance, general investigations, general expenses, and transfers to other agencies.

CHAPTER I

A PROGRAM FOR WATER RESOURCES DEVELOPMENT

1. SCOPE OF THE PROGRAM

The civil works program of the Corps of Engineers constitutes a major portion of the Federal plan for developing and using the Nation's water resources. The program has grown until it constitutes a multi-million-dollar activity in the 50 States, the District of Columbia, and possessions, for navigation, flood control, hydropower and related purposes, and also for beach erosion control.

Navigation improvements at both coastal and Great Lakes Harbors and channels generally involve the dredging of channels and anchorages and the protection of entrances and anchorages by jetties and breakwaters. Rivers are improved for navigation by dredging, regulating works, and canalization by locks and dams. Flood control is accomplished by increasing the carrying capacity of stream channels, by diversion channels, by reservoir storage of floodwaters, and by levees and floodwalls.

The program naturally affords possibilities for conservation and use of water resources. Reservoir projects often develop hydroelectric power; store water for industrial, municipal, and agricultural use; and improve low-water flows. In many cases the projects furnish large public recreational values and preserve and enhance fish and wildlife resources. Congress has specified the areas to be investigated, prescribed the policies to be followed, and defined the limits of Federal participation.

2. STATUS OF PROGRAM

Federal activity in providing navigation improvements dates back to the River and Harbor Act passed in 1824. Major growth of the water resources program has come since 1928, when Congress adopted the project for the alluvial valley of the Mississippi and, particularly, since 1936 when Federal participation in flood control on a nationwide basis was first authorized.

2 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

The status of the active program, as of June 30, 1960, was as follows:

Active Civil Works Program

Status	Number of projects or project authorizations	Estimated cost, 1960	Appropriations through fiscal year 1960	Required to complete
Completed or substantially completed-----	2, 517	3, 580	3, 549	31
Under construction-----	417	9, 742	5, 723	4, 019
Authorized, not started-----	401	4, 906	39	4, 867
Total-----	3, 335	18, 228	9, 311	8, 917

3. ORGANIZATION

Civil works is accomplished through a decentralized organization comprised of 11 divisions which are subdivided into 38 districts completely covering the United States, Territories, and oversea possessions. Boundaries between divisions are selected so as to place, to the extent practicable, a river basin or coastal area within a single division.

The field offices, administered by officers of the Corps of Engineers, employ about 27,000 civilians engaged in civil works, exclusive of contractors' personnel.

CHAPTER II

BENEFITS OF THE PROGRAM

Since 1824 the Corps of Engineers has built and maintained the Nation's harbors and navigable waterways, and since 1936, when the Federal Government assumed responsibility for nationwide flood control, the Corps has been assigned the major responsibility for carrying out that task. The active program, including the \$1.5 billion Mississippi River and tributaries project authorized in 1928, consists of about 3,330 projects authorized by law having an estimated cost of \$18.2 billion. Projects costing \$3.5 billion have been completed, and an additional \$5.8 billion has been invested in projects under construction. Uncompleted portions of work underway, and authorized projects not started, aggregate about \$8.9 billion. The water resources projects now in operation have reduced transportation costs, reduced flood damages, and provided electric energy, water supply, irrigation, low flow regulation, recreational development, and preservation and enhancement of fish and wildlife.

1. NAVIGATION

The navigation element consists of three major parts: coastal harbors and channels, Great Lakes harbors and channels, and inland waterways. In 1959 deep-draft traffic in coastal harbors and channels amounted to 476 million tons of foreign and domestic commerce. There moved on the Great Lakes 187 million tons and on the inland waterways 389 million tons. These three elements aggregate 1,052 million tons. The total inland waterway movement amounted to 197 billion ton-miles, of which 80 billion ton-miles moved on the Great Lakes and 117 billion ton-miles on the rest of the inland waterways. Each of these three systems has, by savings in transportation costs, more than justified construction and operating costs. (An analysis of that program, based on 1953 costs and commerce, is contained in vol. 1 of the 1955 annual report.)

Coastal harbors and channels. Natural harbors and channels are being progressively improved to provide the greater depths required for ocean carriers of today. Depths of 35 feet now generally prevail at major harbors on the Atlantic and gulf coasts, ranging up to 45 feet in New York Harbor. Depths of 30 to 40 feet are generally available along the Pacific coast. Harbors and channels of lesser depth also have been provided for commercial fishing, recreational boating and harbors of refuge.

Great Lakes harbors and channels. These vast water areas, joined by the connecting channels, provide a low-cost transport artery that

permits movement of materials and products in huge quantities to advantageously located industrial areas. Controlling depths in the connecting channels are generally 21 feet in upbound, and 25 feet in downbound channels. Improvements to provide depths of at least 27 feet are underway and scheduled to be usable in 1962.

The Great Lakes are connected with the Gulf of Mexico by means of 9-foot barge navigation on the Illinois Waterway and Mississippi River, and with the Atlantic Ocean by the New York State barge canal system and the Hudson River, and by the 27-foot St. Lawrence Seaway.

There are 58 federally improved harbors on the Great Lakes with project depths of 18 feet or more, of which 15 provide depths of 25 feet or more. The omnibus River and Harbor and Flood Control Act, signed by the President shortly after the end of the fiscal year, authorized further improvement of many of these harbors to provide depths consistent with those being provided in the connecting channels.

Inland and intracoastal waterways. These waterways have proved their worth as routes for low-cost movement of bulk commodities to supplement the major forms of overland transport.

The Federal Government has improved in varying degree some 22,000 miles of inland waterways, of which about 19,000 miles are currently in commercial use. Ton-mileage on the inland waterways increased 8 percent during the past year.

2. FLOOD CONTROL

The first major Federal participation in flood control began in 1928 when Congress adopted the present project for flood control and navigation in the alluvial valley of the Mississippi. The responsibility for nationwide flood control was assigned to the Corps of Engineers by the 1936 Flood Control Act, which also established the Federal policy for that activity.

The flood control program, including the \$1.5 billion Mississippi River and tributaries project, is estimated to cost \$7.2 billion. Since 1936 the Corps of Engineers has completed nearly 400 projects having a cost of almost \$1 billion. Projects having an estimated cost of \$4.3 billion are under construction, and the remainder of the active program, estimated to cost \$1.9 billion, has not been started. Many multiple-purpose reservoir projects with power also provide important flood control benefits.

Corps of Engineers projects have been highly effective in reducing flood damages. During the limited period they have been in operation (generally averaging less than 13 years) they have prevented flood damages of more than \$9.7 billion. About \$500 million of flood

damage was prevented during fiscal year 1960. Following is a tabulation of flood damages prevented during the fiscal year and the cumulative totals to date.

<i>Drainage basin or region</i>	<i>Fiscal year 1960</i>	<i>Cumulative to date</i>
	<i>(In millions of dollars)</i>	
Alaska-----	0. 2	2
Arkansas-White-Red-----	32. 3	221
Central and South Pacific-----	4. 9	174
Central Valley-----	Minor	550
Colorado-----	Minor	Minor
Columbia-----	4. 7	200
Great Basin-----	Minor	Minor
Great Lakes-St. Lawrence-----	4. 2	16
Gulf and South Atlantic-----	7. 7	64
Hawaii-----	Minor	Minor
Lower Mississippi-----	30. 2	6, 050
Middle Atlantic-----	25. 7	162
Missouri-----	249. 3	1, 026
New England-----	40. 1	148
North Pacific-----	1. 0	5
Ohio-----	46. 5	699
Rio Grande and Gulf-----	37. 0	190
Souris-Red-----	Minor	7
Upper Mississippi-----	11. 5	207
Total-----	495. 3	9, 721

The Nation will remain vulnerable to severe flood damage from major floods until an adequate degree of protection is achieved. This goal may be reached through orderly prosecution of existing flood control plans, expanded to meet economic development taking place in flood plains. The results from operating flood control projects prove that much of the flood damage now experienced can be economically prevented. Floods occurred in the Texas portion of the Rio Grande and Gulf region in October 1959, the Ohio River Basin in March 1960, and the Missouri River Basin in April 1960. Flood damages were relatively minor, as existing works prevented an estimated \$333 million in flood damages in these three regions.

3. OTHER BENEFITS

Large benefits in addition to navigation and flood control accrue through conservation and wise use of our water resources. These include hydroelectric power; water for industrial, municipal, and agricultural use; and numerous benefits that result from low-flow regulation. In many cases projects also provide public recreational values and enhance fish and wildlife resources.

Hydroelectric power. The position of hydroelectric power develop-

ment in the civil works program has grown with the increasing needs of the Nation for electric energy, with the greater knowledge accumulated in recent years of the ability of rivers to supply that power, and as a result of the expanding Federal interest in its development and use.

The civil works program, involving the construction of reservoirs, has afforded large possibilities for the development of waterpower. Hydroelectric power production at Corps' projects in operation during fiscal year 1960 amounted to almost 28 billion net kilowatt-hours of electric energy. This represents about 20 percent of the hydroelectric power production, and about 3.5 percent of the total electric production, from all public and private electrical generating plants in the Nation.

Hydroelectric Power Provided by Corps of Engineers Reservoirs

Project	Region	Initial operation fiscal year	Capacity 1,000 KW	Net generation fiscal year 1960 billion KWH	Net generation cumulative through fiscal year 1960 billion KWH
Blakely Mountain, Ark.....	A-W-R.....	1955	75	0.16	0.79
Bull Shoals, Ark. and Mo.....	do.....	1952	160	.42	3.78
Denison, Okla. and Tex.....	do.....	1945	70	.27	2.73
Fort Gibson, Okla.....	do.....	1953	45	.27	.87
Narrows, Ark.....	do.....	1950	17	.03	.33
Norfolk, Ark. and Mo.....	do.....	1944	70	.17	2.84
Table Rock, Mo. and Ark.....	do.....	1959	100	.21	.22
Tenkiller Ferry, Okla.....	do.....	1953	34	.13	.57
Albeni Falls, Idaho.....	Columbia.....	1955	43	.25	1.21
Bonneville, Oreg. and Wash.....	do.....	1938	518	3.43	71.02
Chief Joseph, Wash.....	do.....	1955	1,024	4.35	21.75
Detroit, Oreg.....	do.....	1953	118	.50	3.42
Lookout Point, Oreg.....	do.....	1954	135	.39	2.37
McNary, Oreg. and Wash.....	do.....	1953	980	5.38	32.93
The Dalles, Oreg. and Wash.....	do.....	1957	963	4.08	8.70
St. Marys, Mich.....	GL&StL.....	1951	18	.16	1.08
Allatoona, Ga.....	G&SAtl.....	1950	74	.13	1.29
Buford, Ga.....	do.....	1957	86	.22	.37
Clark Hill, Ga. and S.C.....	do.....	1953	280	.85	3.98
Jim Woodruff, Fla. and Ga.....	do.....	1957	30	.24	.74
John H. Kerr, N.C. and Va.....	Mid Atl.....	1952	204	.58	2.84
Philpott, Va.....	do.....	1953	14	.04	.15
Fort Peck, Mont.....	Missouri.....	1943	85	.71	6.96
Fort Randall, S. Dak.....	do.....	1954	320	1.07	6.21
Garrison, N. Dak.....	do.....	1956	400	1.26	4.74
Gavins Point, Nebr. and S. Dak.....	do.....	1956	100	.47	1.72
Center Hill, Tenn.....	Ohio.....	1950	135	.39	3.49
Cheatham, Tenn.....	do.....	1958	24	.14	.22
Dale Hollow, Tenn.....	do.....	1948	54	.12	1.48
Old Hickory, Tenn.....	do.....	1957	100	.53	1.56
Wolf Creek, Ky.....	do.....	1951	270	.85	7.17
Whitney, Tex.....	R&G&Gulf.....	1953	30	.07	.36
Total.....			6,576	27.87	197.89

Water supply—Domestic and industrial. Growth of population and increased demands of manufacturing processes have focused the attention of public officials on the need for adequate amounts of water of a suitable quality. Adequate water supplies are a problem for many communities and the availability of additional supplies will greatly affect their future growth and the development of new industries. As a result, many States are considering legislation to safeguard water supplies in the best overall public interest.

The Corps of Engineers has legislative authority to provide storage for water supply, provided local interests pay the cost. The Water Supply Act of 1958 provided a broadened authority by permitting consideration of water supply storage for future needs. Under that act and various prior authorities, numerous communities have obtained water supplies from Corps of Engineers reservoirs. At present the Corps of Engineers is providing 1.5 million acre-feet of water storage in 19 reservoirs for more than 40 cities. During the year about 1 million acre-feet of water was supplied for domestic and industrial use. About 660,098 acre-feet of storage under agreement will be provided by nine projects under construction, as listed below.

Water Supply Storage Provided by the Corps of Engineers

<i>In operation</i>		
<i>Project</i>	<i>Water supply storage (acre-feet)</i>	<i>Local agency</i>
Baldhill, N. Dak.-----	*69, 500	Eastern North Dakota, Water Development Association.
Belton, Tex.-----	12, 000	Fort Hood, Tex.
Do-----	113, 700	Brazos River Authority, Tex.
Berlin Dam, Ohio-----	19, 400	Mahoning Valley Sanitary District.
Burr Oak, Ohio (Tom Jenkins)-----	9, 300	State of Ohio.
Canton Dam, Okla.-----	90, 000	Oklahoma City, Okla.
Clark Hill, Ga. and S.C.-----	210	McCormick, S.C.
Dam B, Tex.**-----	94, 200	Lower Neches Valley Authority, Tex.
Ferrells Bridge, Tex.-----	251, 100	Northeast Texas Municipal Water District.
Grapevine, Tex.-----	85, 000	Dallas, Tex.
Do-----	50, 000	Park Cities, Tex.
Do-----	1, 250	Grapevine, Tex.
Heyburn, Okla.-----	1, 000	Kiefer, Okla.
Homme, N. Dak.-----	*3, 650	Grafton and Park River, N. Dak.
Hords Creek, Tex.-----	5, 780	Coleman, Tex.
Hulah, Tex.-----	15, 400	Bartlesville, Okla.
Lake Texoma, Okla. and Tex.-----	21, 300	Denison, Tex.
Lavon Dam, Tex.-----	100, 000	North Texas Municipal Water District.

See footnotes at end of table.

*Water Supply Storage Provided by the Corps of Engineers—Continued**In operation—Continued*

<i>Project</i>	<i>Water Supply storage (acre feet)</i>	<i>Local agency</i>
Lewisville, Tex.....	415, 000	Dallas, Tex.
Do.....	21, 000	Denton, Tex.
Mosquito Creek, Ohio.....	11, 000	Warren, Ohio
San Angelo, Tex.....	80, 351	Upper Colorado River Authority
Texarkana, Ark. and Tex.....	*13, 400	Cities of Texarkana, Ark. and Tex.
Subtotal.....	1, 483, 541	

Under Construction

Beaver, Ark.....	***	Beaver Water District, Ark.
Canyon, Tex.....	366, 400	Guadalupe-Blanco River Authority, Tex.
Carlyle, Ill.....	33, 000	State of Illinois.
Council Grove, Kans.....	24, 400	Council Grove and Emporia, Kans.
McGee Bend, Tex.....	***	Lower Neches Valley Authority, Tex.
Navarro Mills, Tex.....	53, 200	Trinity River Authority, Tex.
Oologah, Okla.....	38, 000	Tulsa, Okla.
Do.....	500	Collinsville, Okla.
Do.....	5, 000	Public Service Company, Okla.
Do.....	2, 500	Claremore Foundation, Okla.
Waco, Tex.....	91, 074	Brazos River Authority, Tex.
Do.....	13, 024	Waco, Tex.
Wilkesboro, N.C.....	33, 000	Winston-Salem, N.C., and Wilkes County, N.C.
Subtotal.....	660, 098	
Total.....	2, 143, 639	

*Seasonal for flood control and water supply.

**Much of the water is presently used for rice irrigation.

***Water supply and power storage combined.

Water supply—Low-flow regulation. Conservation releases of over 4 million acre-feet, together with 29 million acre-feet from hydro-power generation, improved the quantity and quality of downstream flows, which benefited water supplies, recreation, and fish and wildlife.

Water supply—Irrigation. About 4 million acre-feet of irrigation storage space is being operated either exclusively or jointly for irrigation and other uses, as shown in the following tabulation. An additional 677,000 acre-feet of joint-use storage (under agreement) will be provided by projects under construction.

Irrigation Storage in Corps of Engineers Reservoirs

[In thousands of acre-feet]

<i>Project</i>	<i>Exclusive irrigation storage</i>	<i>Joint-use storage</i>
<i>In operation</i>		
Conchas, N. Mex.....	279	-----
Cottage Grove, Oreg.....	-----	30
Detroit, Oreg.....	-----	300
Dorena, Oreg.....	-----	70
Fern Ridge, Oreg.....	-----	95
Folsom, Calif.*.....	-----	512
Harlan County, Nebr.....	150	-----
Isabella, Calif.....	-----	535
John Martin, Colo.....	384	-----
Lookout Point, Oreg.....	-----	340
Lucky Peak, Idaho.....	-----	280
Pine Flat, Calif.....	-----	1,000
Total.....	813	3,162
<i>Under construction</i>		
Black Butte, Calif.....	-----	150
New Hogan, Calif.....	-----	310
Success, Calif.....	-----	75
Terminus, Calif.....	-----	142
Total.....	-----	677

*Operated by the Bureau of Reclamation.

4. PUBLIC RECREATION USE OF PROJECT AREAS

Civil works lands and waters are being used by more and more people for a greater variety of public recreation opportunities. On reservoir projects particularly, picnicking, boating, fishing, and camping are the most popular activities with family camping and water skiing showing the fastest growth and presenting the biggest problems of management. Total attendance increased to 106 million in calendar year 1959, compared with 95 million in 1958. During the same period watercraft increased from 100,000 to a new total of 119,000 boats.

The majority of the recreational facilities and services available to the public at civil works projects are provided or are planned to be provided at other than Federal expenditure, either by public agencies (State, county, metropolitan, or municipal) or by commercial concession arrangements. Most of the Federal expenditures are made in providing better roads, parking areas, boat launching ramps, water wells, and toilets. Concessionaires have also enlarged their facilities, particularly those providing boat care or overnight accommodations.

Safer boating is anticipated through enforcement of State boating acts which were passed to further the objectives of the Federal Boating Act of 1958.

5. FISH AND WILDLIFE

Fishing and hunting days are a significant percentage (probably 5 to 10 percent) of the 106 million public attendance in 1959. Fish and waterfowl resources are enhanced by the water area made available. Game management on 2.7 million acres of project lands above normal water areas has in many instances compensated for loss of natural habitat by inundation. A catch of more than 20 million pounds of sport fish was reported, but this does not represent the total sport fish caught nor does it include the commercial fish taken.

CHAPTER III

PROJECT CONSTRUCTION AND OPERATIONS PROGRESS

The civil works program of the Corps of Engineers comprising navigation, flood control, and multiple-purpose projects, and various related activities, was diligently prosecuted during the fiscal year. Notable progress was made in carrying out project construction and placing additional works in useful operation. Construction was initiated on 49 new projects and on new features at 10 Mississippi River flood-control projects. Also, construction operations were carried out on 154 additional projects. Fifty-eight projects including features at eight multiple-purpose projects were placed in effective operation. A summary of project construction and operations by classes follows:

1. NAVIGATION

The present program for rivers and harbors as specifically authorized by the Congress includes projects located throughout the United States and Puerto Rico. These projects are of various types: deep-draft harbors accommodating oceangoing vessels, shallow-draft channels for general small-boat navigation, inland waterways for commercial barge navigation, and the Great Lakes harbors and connecting waterways.

Construction. During the fiscal year 1960, active construction operations were carried out on 100 navigation projects, of which 34 were placed in useful operation as shown in table 1.

Table 1. Navigation Improvements Placed in Useful Operation During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)

Project	Fiscal year started	Month placed in useful operation	Nature of improvement
Josias River, Maine-----	1960	Mar 60	Dredging.
Boston Harbor, Mass-----	1957	May 60	Dredging anchorage.
Duxbury Harbor, Mass-----	1959	Jan 60	Dredging
Hyannis Harbor, Mass-----	1959	Nov 59	Do.
Scituate Harbor, Mass-----	1959	Jul 59	Do.
New York and New Jersey Channel, N.Y. and N.J.	1954	Jun 60	Dredging and rock removal.
Nanticoke River, Md. (channel)----	1960	Oct 59	Dredging.
Norfolk Harbor, Va.:			
Widen 40' channel-----	1958	Jun 60	Do.
Craney Island Anchorages-----	1960	May 60	Do.

12 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

Table 1. Navigation Improvements Placed in Useful Operation During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)—Continued

Project	Fiscal year started	Month placed in useful operation	Nature of improvement
Manteo (Shallowbag) Bay, N.C.:			
Channel to Manteo-----	1960	Mar 60	Dredging.
Channel to Wanchese-----	1960	Mar 60	Do.
Beaufort Harbor, N.C.-----	1960	Jan 60	Do.
Channel Connecting Thoroughfare Bay with Cedar Bay, N.C.	1960	Oct 59	Do.
Brunswick Harbor, Ga.-----	1959	May 60	Do.
Hillsboro River (Tampa Harbor), Fla.	1959	Jan 60	Do.
IWW, Jacksonville to Miami, Fla., Eau Gallie to Fort Pierce.	1958	Jun 60	Do.
Tampa Harbor, Fla.-----	1956	Feb 60	Do.
Escambia and Conecuh Rivers, Fla. and Ala.	1960	Jun 60	Do.
Dauphin Island Bay, Ala. (Fort Gaines Channel).	1959	Jul 59	Do.
Houston Ship Channel, Tex.-----	1950	May 60	Do.
Brazos Island Harbor, Tex.-----	1957	May 60	Do.
Texas City Channel, Tex.-----	1959	Apr 60	Do.
Dam 8, Monongahela River, W. Va.	1958	Aug 59	Raise crest of dam.
Grand Marais Harbor, Minn.-----	1959	Oct 59	Small boat harbor.
Lac La Belle Harbor, Mich.-----	1960	Feb 60	Do.
Kenosha Harbor, Wis.-----	1959	Aug 59	Dredging.
Harrisville Harbor, Mich.-----	1959	Sep 59	Dredging and break-water.
Port Austin Harbor, Mich.-----	1958	Aug 59	Do.
Ashtabula Harbor, Ohio.-----	1956	Apr 60	Deepening east outer harbor.
Oswego Harbor, N.Y.-----	1957	Jun 60	Breakwater.
San Diego River and Mission Bay, Calif.	1948	Sep 59	Dredging and jetties.
Port Angeles Harbor, Wash.-----	1959	Aug 59	Dredging and break-water.
Quillayute River, Wash.-----	1957	Feb 60	Do.
Neva Straight, Alaska.-----	1959	Sep 59	Dredging.
Dry Pass, Alaska.-----	1959	Sep 59	Do.
Rocky Pass, Alaska.-----	1960	Jan 60	Do.

In fiscal year 1960, work was initiated on 22 navigation projects listed in table 2.

The 45 navigation projects having major construction activity underway at the close of the fiscal year, exclusive of the 22 new starts listed in table 2, are shown in table 3.

Maintenance. Maintenance and operation activities were conducted on 260 navigation projects during the fiscal year at a cost of \$79,810,061. In addition, costs of \$2,014,284 were incurred on activities for the protection of navigation and surveys of northern and northwestern lakes. In allocating the funds being provided for project maintenance, every effort consistent with budgetary requirements is made to maintain navigation projects adequately to serve

*Table 2. Navigation Improvements Initiated During Fiscal Year 1960
(July 1, 1959 to June 30, 1960)*

Project	Month started	Scheduled fiscal year completion	Nature of improvement
Boston Harbor (Reserved Channel), Mass.	May 60	1961	Dredging.
Cohasset Harbor, Mass.-----	Jun 60	1961	Do.
New York and New Jersey Channel, N.Y. and N.J.	Oct 59	1961	Dredging and rock removal (widening in vicinity of B. & O. R.R. Bridge).
Hudson River, N.Y.-----	Jun 60	1967	Dredging and rock removal.
New York Harbor (channel along New Jersey Pierhead Line), N.Y.	May 60	1961	Dredging (Widening at northerly and southerly bends).
Nanticoke River, Md. (jetties)-----	Nov 59	1961	Construction.
Morehead City Harbor, N.C.-----	Jun 60	1961	Dredging.
Manteo (Shallowbag) Bay, N.C. Oregon Inlet	Jun 60	1961	Do
IWW, Caloosahatchee River to Anclote River, Fla.	Jun 60	1965	Do.
Pascagoula Harbor, Miss.-----	Dec 59	1961	Do.
Barataria Bay W.W., La.-----	May 60	1961	Do.
Mississippi River, Baton Rouge to Gulf of Mexico, La.	Mar 60	1963	Dredging and construction.
GIWW, Channel to Port Mansfield, Tex.	Jun 60	1962	Dredging and jetty.
Bayfield Harbor, Wis.-----	Nov 59	1961	Small boat harbor.
Big Bay Harbor, Mich.-----	Apr 60	1961	Do.
Muscatine, Iowa.-----	Nov 59	1961	Do.
Fort Madison, Iowa.-----	Jun 60	1961	Do.
Two Rivers Harbors, Wis.-----	May 60	1961	Dredging
Manistique Harbor, Mich.-----	Jun 60	1961	Do.
Ashtabula Harbor, Ohio.-----	Apr 60	1961	Extension river channel.
Redwood City Harbor, Calif.-----	Jun 60	1961	Dredging.
Gastineau Channel, Alaska.-----	Aug 59	1961	Do.

14 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

*Table 3. Navigation Improvements Under Construction During Fiscal Year 1960
(July 1, 1959, to June 30, 1960)*

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Salem Harbor, Mass.-----	1959	1961	Dredging and rock removal.
Weymouth-Fore River, Mass.-----	1958	1961	Do.
Great Lakes to Hudson River Waterway, N.Y.	1954	1966	Dredging, lowering sills on locks and guard gates and raising bridges.
Delaware River, Philadelphia, Pa., to Trenton, N.J.	1957	1964	Dredging and bridge reconstruction.
Inland Waterway, Delaware River to Chesapeake Bay, Del. and Md.	1957	1961	Summit bridge.
Savannah River below Augusta, Ga:			
Channel Cut-Off-----	1959	1961	Dredging:
Dikes and Revetments-----	1959	1961	Construction of pile dikes and bank revetments.
Aquatic Plant Control, Louisiana and Florida.	1959	1966	Control and eradication obnoxious aquatic plant growths.
Apalachicola, Chattahoochee, and Flint Rivers, Ala., Ga., and Fla.	1959	1964	Construction of Columbia Lock and Dam.
Black Warrior, Warrior, and Tombigbee Rivers, Ala.	1957	1961	Construction of Jackson Lock and Dam.
Gulf Intracoastal Waterway:			
1. Algiers Alternate Connection--	1947	1961	Stabilization of canal banks.
2. Port Allen Lock and Canal (Plaquemine-Morgan City Alternate).	1955	1961	Construction of lock and canal.
Port St. Joe Harbor, Fla.-----	1959	1961	Dredging.
Mississippi River-Gulf Outlet, La.---	1958	1967	Dredging and construction.
Dam No. 27, Mississippi River, Ill---	1959	1963	Construction of dam.
Arkansas River and Tributaries, Arkansas and Oklahoma.	1950	1970	Bank stabilization.
Mississippi River between Ohio and Missouri Rivers.	1910	1968	Regulating works.
Galveston Harbor and Channel, Tex.--	1958	1961	Seawall construction.
Gulf Intracoastal Waterway, Tex.:			
1. Gualaupe River, Channel to Victoria.	1958	1965	Dredging.
2. Realinement Vicinity Aransas Pass.	1958	1961	Dredging and highway bridge construction.

Table 3. Navigation Improvements Under Construction During Fiscal Year 1960
(July 1, 1959, to June 30, 1960)—Continued

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Matagorda Ship Channel, Texas	1959	1961	Dredging.
Harbor of Refuge at Port Lavaca.			
Port Aransas-Corpus Christi Waterway, Tex.	1957	1962	Do.
Sabine-Neches Waterway, Tex.-----	1957	1964	Do.
Missouri River, Kansas City to Mouth, Mo.	1912	1963	Bank stabilization.
Missouri River, Kansas City to Sioux City, Iowa.	1928	1968	Do.
Greenup Locks and Dam, Ohio River, Ky.	1955	1961	Replacement for existing Locks and Dams 27-30, inclusive.
Captain Anthony Meldahl Locks and Dam, Ohio River, Ky.	1958	1964	Replacement for existing Locks and Dams 31-34, inclusive.
New Cumberland Locks and Dam, Ohio River, Ohio.	1955	1961	Replacement for existing Locks and Dams 7-9, inclusive.
Pike Island Locks and Dam, Ohio River, W. Va.	1959	1965	Replacement for existing Locks and Dams 10 and 11.
Markland Locks and Dam, Ohio River, Ind.	1956	1962	Replacement for existing Locks and Dams 35-39, inclusive.
McAlpine Locks and Dam, Ohio River, Ky.	1957	1965	Reconstruction of Locks and Dam 41.
Mississippi River at Quincy, Ill.-----	1959	1962	Bridge alteration.
St. Anthony Falls, Mississippi River, Minn.	1949	1963	Lock and dam construction and dredging.
Calumet-Sag Modification, Ill. Waterway, Ill. and Ind.	1956	1966	Channel improvements, bridges alterations and dredging.
St. Marys River, Mich.-----	1958	1963	Dredging.
St. Clair River, Mich.-----	1959	1962	Do.
Detroit River, Mich.-----	1957	1963	Do.
Whitefish Point Harbor, Mich.-----	1957	1961	Do.
Cleveland Harbor, Ohio.-----	1950	1961	Dredging Cuyahoga River and replacement of railroad bridges.

16 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

*Table 3. Navigation Improvements Under Construction During Fiscal Year 1960
(July 1, 1959, to June 30, 1960)—Continued*

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Barcelona Harbor, N.Y.-----	1958	1961	Dredging and break-water.
Buffalo Harbor (North Entrance Channel and Buffalo River), N.Y.	1959	1963	Dredging.
Playa Del Re Inlet and Harbor, Calif.	1958	1962	Small boat harbor.
Port Hueneme Harbor, Calif.-----	1959	1961	Dredging and jetty construction.
Sacramento River Deep Water Ship Channel, Calif.	1950	1963	Dredging and construction.
San Joaquin River-Stockton Deep Water Channel, Calif.	1955	1967	Do.
Halfmoon Bay Harbor, Calif.-----	1959	1962	Breakwaters.
Rogue River Harbor, Gold Beach, Oreg.	1959	1961	Dredging and jetty construction.
Honolulu Harbor, Hawaii (2d Entrance Channel).	1959	1961	Dredging and bridge construction.

the reasonable requirements of commerce and navigation. This fiscal year, as in previous fiscal years, accomplishment of this work was principally confined to deep-draft harbors and major inland waterways, and for a relatively few channels serving areas where hardship to the locality would result from nonmaintenance.

2. SHORE PROTECTION

The policy of Federal assistance in the construction of works for the restoration and protection against erosion by waves and currents applies to shores of the United States and possessions, that are owned by States, municipalities, or other political subdivisions, and also to shores other than public if there is a benefit such as that arising from public use or from the protection of nearby public property or if the benefits to those shores are incidental to the project. Construction of a project is accomplished by local interests or by the Government by mutual agreement.

During fiscal year 1960, operations were carried out on six shore-protection projects as shown in table 4.

3. GENERAL FLOOD CONTROL

The general statutory background and broad description of the authorized flood control general program and the program for the

Table 4. Shore Protection Projects (July 1, 1959, to June 30, 1960)

Project	Fiscal year started	Month placed in useful operation	Scheduled fiscal year completion	Nature of improvement
Guilford Point Beach, Conn.	1959-----	Jul 59-----	-----	Groin and sandfill.
Fire Island Inlet, Long Island, N.Y.	1959-----	Jun 60-----	1970-----	Beach replenishment (1st increment completed June 1960).
Atlantic City, N.J.	1948-----	-----	After 1961-----	Jetties, groins, beach replenishment.
Seal Beach, Calif.	1959-----	Sep 59-----	-----	Sandfill and groin.
Ocean Beach, Calif.	See remarks...	See remarks...	-----	Sandfill, groin, and periodic nourishment (completed by local interests prior to authorization—reimbursement of Federal share made during the fiscal year).
Imperial Beach, Calif.	1959-----	-----	Not scheduled.	5 groins—groin No. 1 completed Sep 1959.

Sacramento River, Calif., were discussed on pages 4 through 9 of part 1, volume 1, of the Annual Report of the Chief of Engineers for 1953. Additional authorizations through fiscal year 1958 are described on page 15, volume 1, of the Annual Report of the Chief of Engineers for 1956; on page 11, volume 1, of the Annual Report of the Chief of Engineers for fiscal year 1957; and on pages 13 and 14, volume 1, of the Annual Report of the Chief of Engineers for fiscal year 1958.

Construction. During fiscal year 1960, active construction operations were carried out on 125 specifically authorized flood control projects, of which 16 were fully completed, and an additional 20 were completed for beneficial use as shown in table 5.

During the year, work on 26 specifically authorized flood control projects exclusive of multiple-purpose projects was initiated as shown in table 6.

The 79 flood control projects under active construction during the fiscal year, exclusive of multiple-purpose projects and those projects placed in useful operation or initiated during the year as given in tables 5 and 6, are listed in table 7.

Construction operations were also carried out pursuant to the small project authority contained in section 205 of the 1948 Flood Control Act as amended by Public Law 685, 84th Congress. Eleven small projects were placed in useful operation pursuant to this program and five new projects were initiated during the fiscal year. In addition, design studies were carried out on 70 projects, and plans and specifications were under preparation for 12 projects which are expected to be initiated in fiscal year 1961.

18 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

Table 5. Flood Control Projects Placed in Useful Operation During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)

Project	Fiscal year started	Month placed in useful operation	Nature of project
Abilene, Kans.....	1958	May 60	Local protection.
Amazon Creek, Oreg.....	1951	Aug 59	Do.
Clear Creek Drainage and Levee District, Illinois.	1940	Jun 60	Do.
Coal Creek (Lake City), Tenn.....	1959	Jun 60	Do.
Cumberland, Md., and Ridgeley, W. Va.	1948	Jun 60	Do.
East Barre, Vt.....	1957	Jun 60	Reservoir.
East Brimfield, Mass.....	1958	Jun 60	Do.
Eel River, Calif.....	1959	Nov. 59	Local protection.
Hanapepe River, Hawaii.....	1960	Jan 60	Do.
Kendrick, Potlatch River, Idaho.....	1960	Oct 59	Do.
Marmarth, N. Dak.....	1959	Nov 59	Do.
Memphis, Wolf River and Nonconah Creek, Tenn.	1939	May 60	Do.
Muscatine (Mad Creek), Iowa.....	1958	Dec 59	Do.
Painted Rock, Ariz.....	1956	Dec 59	Reservoir.
Perry County Drainage and Levee Districts 1, 2, and 3, Missouri.	1946	Jul 59	Local protection.
Sutton, W. Va.....	1950	Feb 60	Reservoir.
Walnut Bayou, Ark.....	1958	Dec 59	Local protection.
Wilson, Wenkel and Prairie du Pont Drainage and Levee District, Illinois.	1939	Jun 60	Do.
Woonsocket, R.I.....	1956	May 60	Do.
Worcester, Mass.....	1957	Jan 60	Do.

Table 6. Flood Control Projects Initiated During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)

Project	Month started	Scheduled fiscal year completion	Nature of project
Allegheny River, Pa. and N.Y.....	Dec 59	1965	Reservoir.
Bethlehem, Pa.....	Jun 60	1963	Local protection.
Black Butte, Calif.....	Mar 60	1963	Reservoir.
Enid, Okla.....	Jul 59	1961	Local protection.
Fabius River Drainage District, Missouri.	Aug 59	1961	Do.
John Redmond, Kans.....	Jul 60	1965	Reservoir.
John W. Flannagan, Va.....	Jan 60	1964	Do.
McKinney Bayou and Barkman Creek, Tex. and Ark.	Apr 60	1961	Local protection.
Malheur River, Vale Unit, Oregon..	May 60	1961	Do.

Table 6. Flood Control Projects Initiated During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)—Continued

Project	Month started	Scheduled fiscal year completion	Nature of project
Mill Creek Levees, Calif.-----	May 60	1961	Local protection.
Muscatine Island Levee District and Muscatine-Louisa County Drainage District No. 13, Iowa.	Aug 59	1962	Do.
Navarro Mills, Tex.-----	Jan 60	1961	Reservoir.
New Hogan, Calif.-----	Aug 59	1961	Do.
No. 2 Barren, Ky.-----	Mar 60	1964	Do.
Princeton, W. Va.-----	Mar 60	1961	Local protection.
Proctor, Tex.-----	Jun 60	1965	Reservoir.
Red Rock, Iowa.-----	May 60	1966	Do.
Rio Grande Floodway—Cochiti to Rio Puerco, N. Mex.	Jan 60	1962	Local protection.
Roseville, Ohio.-----	Aug 59	1961	Do.
San Jacinto River and Bautista Creeks, Calif.	Jun 60	1961	Do.
Shenango, Ohio and Pa.-----	May 60	1964	Reservoir.
Sny Basin, Ill.-----	Aug 59	1964	Local protection.
Summersville, W. Va.-----	Feb 60	1965	Reservoir.
Truckee River and Tributaries, California and Nevada.	Aug 59	1961	Local protection.
Two Rivers, N. Mex.-----	Jun 60	1963	Reservoir.
Westville, Mass.-----	May 60	1961	Do.

Table 7. Flood Control Projects Under Construction During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Abiqui, N. Mex.-----	1956	1962	Reservoir and channel.
Adams, Mass.-----	1950	1960	Local protection.
Allentown, Pa.-----	1958	1961	Do.
Anacostia River Basin, D.C. and Md.	1955	1961	Do.
Amite River and Tributaries, La.-----	1957	1961	Do.
Ball Mountain, Vt.-----	1956	1961	Reservoir.
Barbourville, Ky.-----	1955	1961	Local protection.
Battle Creek, Mich.-----	1957	1963	Do.
Bear Creek, Pa.-----	1956	1961	Reservoir.
Beardstown, Ill.-----	1954	1964	Local protection.
Bradford, Pa.-----	1955	1961	Do.
Buckhorn, Ky.-----	1956	1961	Reservoir and channel.
Buffalo Bayou, Tex.-----	1956	1963	Local protection.
Calion, Ark.-----	1957	1961	Do.

20 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

Table 7. Flood Control Projects Under Construction During Fiscal Year 1960
(July 1, 1959, to June 30, 1960)—Continued

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Canyon, Tex.....	1958	1964	Reservoir and channel.
Cape Girardeau, Mo.....	1956	1963	Local protection.
Carbon Canyon, Calif.....	1959	1961	Reservoir.
Carlyle, Ill.....	1958	1966	Reservoir and channel.
Central and Southern Fla.....	1950	After 1967	Local protection.
Cooper, Tex.....	1958	1964	Reservoir and channel.
Devil, East Twin, Warm, and Lytle Creeks, Calif.	1956	1961	Local protection.
Dillon, Ohio.....	1946	1961	Reservoir and channel.
East St. Louis and Vicinity, Ill.....	1937	1963	Local protection.
Endicott, Johnson City, and Vestal, N.Y.	1957	1961	Do.
Greybull, Wyo.....	1958	1961	Do.
Howard A. Hanson, Wash.....	1956	1962	Reservoir.
Hopkinton-Everett, N.H.....	1959	1963	Do.
Jackson Hole, Snake River, Wyo.....	1957	Indefinite	Local protection.
Kansas Citys, Kans. and Mo.....	1940	1963	Do.
Kettle Creek, Pa.....	1959	1961	Reservoir.
Keystone, Okla.....	1957	1965	Reservoir and channel.
Lavaca and Navidad at Hallettsville, Tex.	1959	1961	Local protection.
Little Sioux River, Iowa.....	1956	1962	Do.
Los Angeles County Drainage Area (exclusive of Whittier Narrows Reservoir), Calif.	1935	1965	Do.
Lower Heart River, N. Dak.....	1958	1961	Do.
Lower San Joaquin River, Calif.....	1956	1964	Do.
Mansfield, Ind.....	1956	1961	Reservoir and channel.
Middle Creek, Calif.....	1958	1961	Local protection.
Missouri River, Kenslers Bend, Nebr., to Sioux City, Iowa.	1946	1961	Do.
Multnomah County Drainage District No. 1, Oreg.	1959	1961	Do.
Nolin, Ky.....	1959	1962	Reservoir and channel.
North Adams, Mass.....	1950	1961	Local protection.
North Hartland, Vt.....	1958	1962	Reservoir.
North Springfield, Vt.....	1957	1961	Do.

Table 7. Flood Control Projects Under Construction During Fiscal Year 1960
(July 1, 1959, to June 30, 1960)—Continued

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Ogaholo, Okla.....	1950	1962	Reservoir and channel.
Ottawa, Kans.....	1958	1962	Local protection.
Pasquotank River, N.C.....	1956	1961	Do.
Pendleton, Oreg.....	1959	1961	Do.
Pomona, Kans.....	1959	1963	Reservoir and channel.
Pomme de Terre, Mo.....	1957	1962	Do.
Prompton, Pa.....	1957	1961	Reservoir.
Red River below Denison Dam, Tex..	1948	1963	Local protection.
Red River of the North Basin, Fargo, N. Dak.	1959	1961	Do.
Sacramento River Flood Control Project, California.	1918	1964	Do.
Sacramento River Major and Minor Tributaries, California.	1949	1967	Do.
St. Louis, Mo.....	1959	1969	Do.
Salina, Kans.....	1957	1961	Do.
Salt Lake City, Jordan River, Utah..	1959	1961	Do.
San Antonio Channel Improvement, Tex.	1957	After 1966	Do.
San Antonio and Chino Creeks Channel, Calif.	1956	1961	Do.
San Lorenzo Creek, Calif.....	1959	1961	Do.
San Lorenzo River, Calif.....	1957	1961	Do.
Santa Clara River, Calif.....	1959	1961	Do.
Santa Maria Valley Levees, Calif.....	1959	1961	Do.
Sioux Falls, S. Dak.....	1956	1961	Do.
Stillwater, Pa.....	1957	1961	Reservoir.
Success, Calif.....	1956	1961	Do.
Terminus, Calif.....	1957	1962	Do.
Thomaston, Conn.....	1958	1961	Do.
Topeka, Kans.....	1937	1965	Local protection.
Townshend, Vt.....	1957	1961	Reservoir.
Tuttle Creek, Kans.....	1952	1962	Reservoir and channel.
Vincennes, Ind.....	1952	Indefinite	Local protection.
Waco, Tex.....	1958	1964	Reservoir and channel.
Waterbury, Vt.....	1956	1961	Reservoir.
West Hill, Mass.....	1959	1961	Do.
Whitlow Ranch, Ariz.....	1959	1961	Do.
Willamette River Basin, Bank Protection, Oreg.	1938	1970	Local protection.
Wood River Drainage and Levee District, Illinois.	1947	1962	Do.

Maintenance. Maintenance and operation activities were conducted on 127 flood control projects during the fiscal year at a cost of \$6,180,225.

4. MULTIPLE-PURPOSE (POWER) PROJECTS

The importance of multiple-purpose projects in relation to the overall activities of the Corps of Engineers continued to increase during the fiscal year as a result of the large construction program relating to these projects currently underway and the placing in operation of primary-purpose features at several projects. These projects have been designed to serve primarily in the interest of navigation or flood control and the production of hydroelectric power, although frequently other benefits, such as irrigation, pollution abatement, water supply, and recreation, are also realized.

The inclusion of power features in conjunction with other project features has often resulted in an enhancement of their economic value. Pertinent information on the power aspects of multiple-purpose projects is contained in section 5 of this chapter.

Construction. During the year, construction operations were carried out on 24 multiple-purpose projects.

Table 8. Multiple-Purpose Projects Completed for Full Beneficial Use During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)

Project	Fiscal year started	Scheduled fiscal year completion	Project primary purposes
Gavins Point Reservoir, S. Dak. and Nebr.	1952	1960	Flood control, navigation and power.

During the year, one new multiple-purpose project, Beaver Reservoir, Ark., was started.

Of the 24 multiple-purpose projects under active construction during the fiscal year, 9 projects had some or all primary features in useful operation at the end of the year. These projects are listed in tables 8 and 9.

Of the multiple-purpose projects under active construction at the end of the fiscal year, 15 projects had no primary-project features in operation. They are shown in table 10.

Maintenance. Operation and maintenance activities were conducted on 34 multiple-purpose projects during the fiscal year at a cost of \$17,835,095.

Table 9. Multiple-Purpose Projects Under Construction With Some or All Primary Project Features Placed in Useful Operation During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)

Project	Fiscal year started	Scheduled fiscal year completion	Features placed in operation during fiscal year 1960	Project primary purposes
Table Rock Reservoir, White River, Mo.	1953	1961	-----	Flood control* and power.*
Bull Shoals Reservoir, White River, Ark.	1947	1964	-----	Do.
Cheatham Lock and Dam, Cumberland River, Tenn.	1951	1962	-----	Navigation* and power*
Old Hickory Lock and Dam, Cumberland River, Tenn.	1953	1962	-----	Do.
The Dalles Dam, Columbia River, Wash. and Oreg.	1953	1962	Generators 9 through 12.	Navigation*, power* and irrigation.*
Chief Joseph Dam, Columbia River, Wash.	1960	1963	-----	Power.*
McNary Lock and Dam, Columbia River, Oreg. and Wash.	1947	1964	-----	Navigation* and power.*
Garrison Reservoir, N. Dak.	1947	1963	Generators 4 and 5	Flood control* and power.*

*Projects operated for these primary purposes at the beginning of and throughout fiscal year 1960.

5. HYDROELECTRIC POWER PRODUCTION

The construction and operation of hydroelectric power facilities as part of the Corps of Engineers civil works program for multiple-purpose projects continues to progress. Electric energy production was 4.5 percent above the preceding fiscal year due primarily to improved water conditions in the southwestern and southeastern areas.

Under existing laws, the Corps of Engineers delivers, with one exception, the electric power produced in excess of project requirements to the Department of the Interior for disposition at rates approved by the Federal Power Commission.

Installed capacity. Additional generating capacity of 472,000 kilowatts (nameplate rating) was installed and placed in operation during the fiscal year. This additional capacity consisted of six generating units installed in two operating projects as shown in table 11. This increase in generating capacity represents 30.3 percent of the hydro-

24 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

Table 10. Multiple-Purpose Projects Under Construction and Not Operating During Fiscal Year 1960 (July 1, 1959, to June 30, 1960)

Project	Fiscal year started	Scheduled fiscal year completion	Project primary purposes
Hartwell Reservoir, Savannah River, Ga. and S.C.	1956	1963	Flood control, navigation, and power.
Walter F. George Lock and Dam, Chattahoochee River, Ga. and Ala.	1956	1963	Navigation and power.
McGee Bend Reservoir, Angelina River, Tex.	1957	1966	Flood control and power.
Greers Ferry Reservoir, White River, Ark.	1957	1964	Do.
Dardanelle Lock and Dam, Arkansas River, Ark.	1957	1971	Navigation and power.
Eufaula Reservoir, Canadian River, Okla.	1957	1965	Flood control and power.
Fort Peck (2d power plant), Missouri River, Mont.	1957	1962	Power.
Big Bend Reservoir, Missouri River, S. Dak.	1959	1967	Power and flood control.
Oahe Reservoir, Missouri River, N. Dak. and S. Dak.	1949	1965	Flood control, navigation, power and irrigation.
Barkley Dam, Cumberland River, Ky.	1957	1966	Flood control, navigation, and power.
Cougar Reservoir, McKenzie River, Oreg.	1956	1964	Flood control, power, navigation, and irrigation.
Hills Creek Reservoir, Willamette River, Oreg.	1956	1963	Do.
John Day Lock and Dam, Columbia River, Oreg. and Wash.	1958	1969	Do.
Ice Harbor Lock and Dam, Snake River, Oreg., Wash. and Idaho.	1956	1962	Do.
Beaver Reservoir, White River, Ark.	1960	1966	Power, flood control, water supply.

electric capacity and 3.98 percent of the total generating capacity added to the Nation's utility systems during the fiscal year.

As of June 30, 1960, the Corps of Engineers had a total of 6,576,400 kilowatts of nameplate generating capacity in operation at 32 projects as listed in table 12. The 312,000 kilowatts installed in The Dalles project and the 160,000 kilowatts installed in the Garrison project were substantial additions to the generating capacity of the North-

western and Missouri River Basin areas, respectively. At the end of the fiscal year, total generating capacity, in operation at Corps of Engineers multiple-purpose projects with power, represented 4.07 percent of the total generating capacity and 20.8 percent of the hydroelectric generating capacity supplying the Nation's utility systems.

Hydroelectric power production. During the fiscal year the production of electric energy at Corps of Engineers projects amounted to 27.9 billion net kilowatt-hours, or 1.2 billion more than produced during fiscal year 1959. Improvement in streamflows, particularly in the southwest and southeast, was primarily responsible for this increase in energy production. Corps of Engineers power production for fiscal year 1960 represents approximately 3.8 percent of the total electric energy produced and 19.0 percent of the hydroelectric energy produced by the Nation's utility systems for this period. Chart I illustrates the trend of power production for Corps of Engineers multiple-purpose projects with power.

Additional capacity under construction. As of June 30, 1960, the Corps of Engineers had 528,000 kilowatts of additional capacity at 5 operating projects and 3,466,000 kilowatts of capacity at 14 new projects for a total of 3,994,000 kilowatts of capacity under construction as listed in tables 12 and 13.

Projects in operation and under construction have a total ultimate capacity of 14,551,400 kilowatts, of which, under construction schedules at the beginning of fiscal year 1961, 6,924,400 kilowatts of capacity will be in operation by June 30, 1961. Chart II shows the continuing increase of installed capacity at Corps of Engineers projects in recent years.

Table 11. Generating Capacity Placed in Service During Fiscal Year 1960

	Size of units (kilowatts)	Number of units	Added capacity (kilowatts)
Garrison, N. Dak.-----	80, 000	2	160, 000
The Dalles, Oreg. and Wash.-----	78, 000	4	312, 000
Totals-----	-----	6	472, 000

HYDROELECTRIC POWER PRODUCTION
NET ANNUAL KILOWATT-HOURS

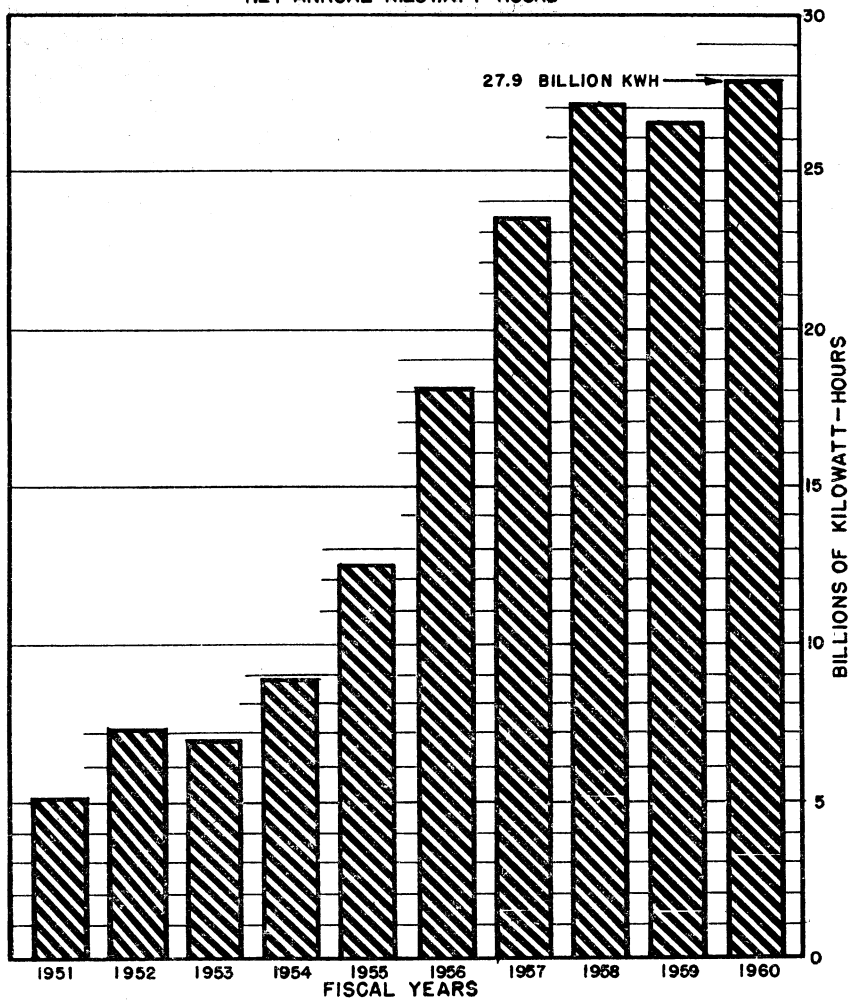


Chart I

HYDROELECTRIC GENERATING CAPACITY OPERATING AND SCHEDULED

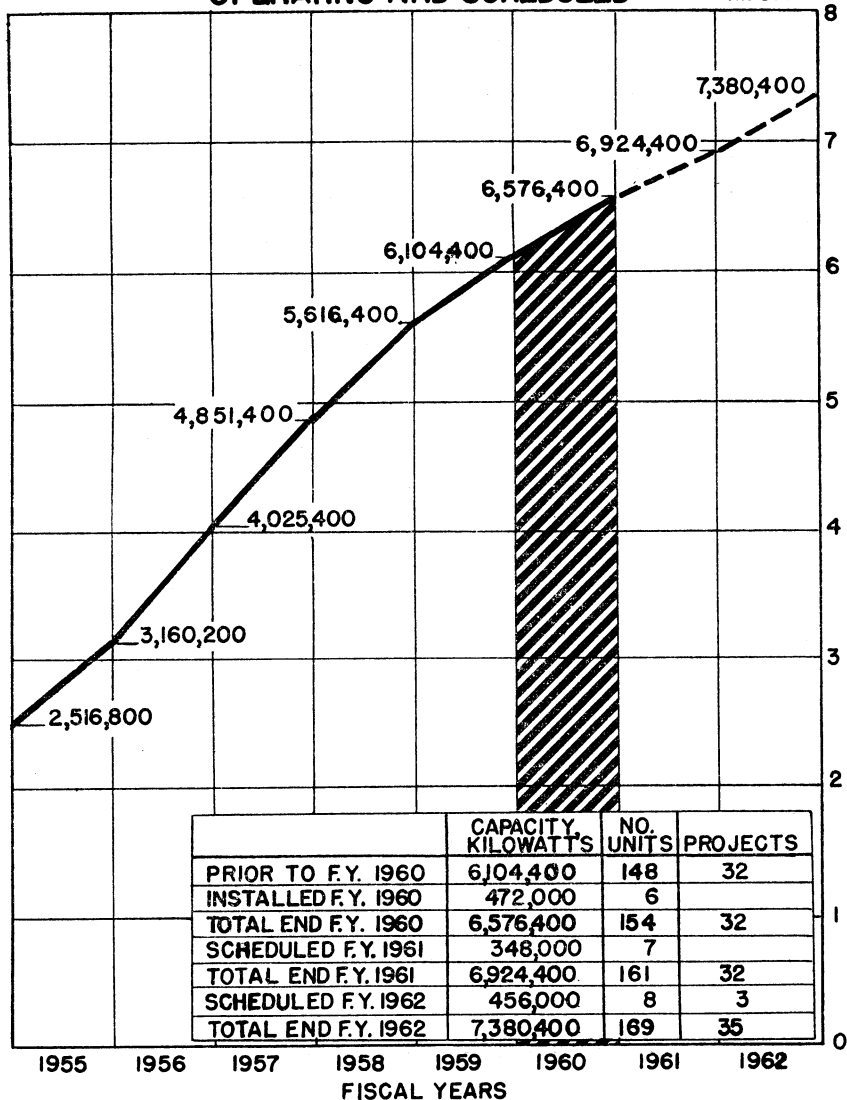
MILLIONS OF
KILOWATTS

Chart II

Table 12. *Hydroelectric Projects in Operation June 30, 1960*

Project	Initial operation fiscal year	Nameplate capacity—kilowatts		
		Existing installation	Under construction	Ultimate construction
Albeni Falls, Idaho-----	1955	42, 600	-----	42, 600
Allatoona, Ga.-----	1950	74, 000	-----	110, 000
Blakely Mountain, Ark-----	1956	75, 000	-----	75, 000
Bonneville, Oreg. and Wash-----	1938	518, 400	-----	518, 400
Buford, Ga-----	1957	86, 000	-----	86, 000
Bull Shoals, Ark. and Mo-----	1953	160, 000	180, 000	340, 000
Center Hill, Tenn-----	1951	135, 000	-----	135, 000
Cheatham, Tenn-----	1958	24, 000	12, 000	36, 000
Chief Joseph, Wash-----	1956	1, 024, 000	-----	1, 728, 000
Clark Hill, Ga. and S.C-----	1953	280, 000	-----	280, 000
Dale Hollow, Tenn-----	1949	54, 000	-----	54, 000
Denison, Okla. and Tex-----	1945	70, 000	-----	175, 000
Detroit, Oreg-----	1954	118, 000	-----	118, 000
Fort Gibson, Okla-----	1953	45, 000	-----	67, 500
Fort Peck, Mont-----	1944	85, 000	80, 000	165, 000
Fort Randall, S. Dak-----	1954	320, 000	-----	320, 000
Garrison, N. Dak-----	1956	400, 000	-----	400, 000
Gavins Point, Nebr. and S. Dak-----	1957	100, 000	-----	100, 000
Jim Woodruff, Fla. and Ga-----	1957	30, 000	-----	30, 000
John H. Kerr, N.C. and Va-----	1953	204, 000	-----	204, 000
Lookout Point, Oreg-----	1955	135, 000	-----	135, 000
McNary, Oreg. and Wash-----	1954	980, 000	-----	1, 400, 000
Narrows, Ark-----	1950	17, 000	-----	25, 500
Norfolk, Ark. and Mo-----	1944	70, 000	-----	140, 000
Old Hickory, Tenn-----	1957	100, 000	-----	100, 000
Philpott, Va-----	1954	14, 000	-----	14, 000
St. Marys, Mich-----	1952	18, 400	-----	18, 400
Table Rock, Ark. and Mo-----	1959	100, 000	100, 000	200, 000
Tenkiller Ferry, Okla-----	1954	34, 000	-----	34, 000
The Dalles, Oreg. and Wash-----	1957	963, 000	156, 000	1, 743, 000
Whitney, Tex-----	1954	30, 000	-----	30, 000
Wolf Creek, Ky-----	1952	270, 000	-----	270, 000
Total, projects in operation-----	-----	6, 576, 400	528, 000	9, 094, 400

Table 13. *Hydroelectric Projects Under Construction June 30, 1960*

Project	Scheduled operation, fiscal year	Nameplate capacity—kilowatts		
		Existing installation	Under construction	Ultimate installation
Barkley, Ky. and Tenn.....	1965	-----	130, 000	130, 000
Beaver, Ark.....	1965	-----	112, 000	112, 000
Big Bend, S. Dak.....	1965	-----	468, 000	468, 000
Cougar, Oreg.....	1963	-----	25, 000	60, 000
Dardanelle, Ark.....	1965	-----	124, 000	124, 000
Eufaula, Okla.....	1965	-----	90, 000	90, 000
Greers Ferry, Ark.....	1964	-----	96, 000	96, 000
Hartwell, Ga. and S.C.....	1962	-----	264, 000	330, 000
Hills Creek, Oreg.....	1962	-----	30, 000	30, 000
Ice Harbor, Wash.....	1962	-----	270, 000	540, 000
John Day, Oreg. and Wash.....	1967	-----	1, 080, 000	2, 700, 000
McGee Bend, Tex.....	1965	-----	52, 000	52, 000
Oahe, N. Dak. and S. Dak.....	1963	-----	595, 000	595, 000
Walter F. George, Ala. and Fla.....	1963	-----	130, 000	130, 000
Total projects under construction.....	-----	-----	3, 466, 000	5, 457, 000
Total projects in operation (table 12).....	-----	6, 576, 400	528, 000	9, 094, 400
Total.....	-----	6, 576, 400	3, 994, 000	14, 551, 400
Total projects in operation and under construction.....	-----	10, 570, 400		

6. MISSISSIPPI RIVER FLOOD CONTROL

The project for Mississippi River and tributaries, authorized by the Flood Control Act of May 15, 1928, and subsequent amendments, provides for flood protection of its alluvial valley below Cape Girardeau, Mo., from Mississippi River and local floods by means of levees and floodwalls, channel realinement and stabilization, reservoirs, floodways and outlets, and drainage works. Authorizations through 1953 are described on pages 10 and 11 of part I, volume I, of the Annual Report of the Chief of Engineers for 1953. Amendments to the project in the flood control acts approved September 3, 1954, and July 3, 1958, are described in the reports of 1955 and 1959, respectively.

The total authorization for the project at the end of the fiscal year is \$1,398,877,100, of which \$1,108,593,600 has been appropriated and \$1,102,627,064 has been expended.

Construction. During the year, the following items of construction in seven projects have been completed.

Table 14. *Project Features Which Have Been Fully Completed During the Year*

Project features	Date completed	Nature of project feature
Mississippi River at Vicksburg Harbor, Miss.	Nov 59-----	Retaining dikes and approach fill.
Old River control, La-----	Oct 59-----	Overbank structure.
Morganza Floodway, La-----	Feb 60-----	Highway 30—Surfacing.
Tensas Basin, Ark-----	Sep 59-----	Canal 19, Ark., channel improvement, Reach 3.
	Aug 59-----	Canal 43, Ark., channel improvement, Reach 2.
	Jul 59-----	Canal 81, Ark., channel improvement, Reach 1.
	Jan 60-----	Canal 81, Ark., channel improvement, Reach 2.
	Aug 59-----	Missouri Pacific RR. bridge over Canal 19, Reach 2.
	Aug 59-----	Arkansas State Highway Nos. 54 and 114 bridges over Canal 19, Reach 3.
	Jul 59-----	Four Desha County bridges over Canal 81, Reach 2.
Red River backwater area, La.	Dec 59-----	Bayou Cocodrie levee enlargement.
Yazoo Basin, Miss-----	Dec 59-----	Lower Auxiliary channel, leveed floodway and landside drainage ditches—mile 17.2 to mile 20.7.
	Dec 59-----	U.S. Highway No. 49—W bridge over Lower Auxiliary channel.
	Oct 59-----	East bank new levee—Yazoo City to Piney Creek.
	Sep 59-----	East bank new levee—Piney Creek to Techeva Creek.
	Dec 59-----	West bank new levee—Yazoo City to Belle Prairie.
	Sep 59-----	Pompey Ditch east bank levee setback.
	Oct 59-----	Belzoni local protection.
	Dec 59-----	Channel improvement, David and Burrell Bayous.
	Oct 59-----	Channel improvement, Little Sunflower River, mile 6.14 to mile 27.75.

Table 14. *Project Features Which Have Been Fully Completed During the Year—Con.*

Project features	Date completed	Nature of project feature
St. Francis Basin, Ark. and Mo.	Nov 59-----	Channel improvements, Big Sunflower River, mile 33.50 to mile 34.75 and mile 77.50 to mile 99.0.
	Aug 59-----	Channel improvement, Bogue Phalia, mile 8.5 to mile 20.9.
	Feb 60-----	Channel improvement, Bogue Phalia, mile 30.0 to mile 47.0.
	Feb 60-----	Channel improvement, Steele Bayou, mile 55.06 to mile 65.97, and Canal 9, mile 0.00 to mile 22.20.
	Jan 60-----	Four Washington County bridges over Canal 9.
	Oct 59-----	Mississippi State Highway No. 450 bridge over Bogue Phalia.
	Sep 21, 59-----	St. Francis River Floodway channel between Madison, Ark., and Marianna, Ark.
	Feb 2, 60-----	Clarks Corner Cutoff Channel.
	Oct 9, 59-----	U.S. Highway 79 crossing over floodway near Marianna, Ark.
	Dec 1, 59-----	Two county bridges over Clarks Corner Cutoff Channel.
	Nov 18, 59-----	U.S. Highway 70 bridge over Round Pond drainage channel.

During the year there were no additional features of projects placed in useful operation.

During the year progress was made in the continuing construction of the principal features of the project on the main stem and on the tributaries in the alluvial valley. Main stem work on levees, revetments, dikes, and dredging was accomplished as follows: New mainline levees constructed 5 miles; main line levees enlarged to grade and section, 27.2 miles; secondary levees constructed, 1.6 miles; bank protection placed, 21.8 miles; dikes constructed, 3.9 miles; and construction dredging, 12,038,000 cubic yards. At the end of the fiscal year, a total of 1,706 miles of main line levees containing 1,100 million

cubic yards had been constructed, of which 1,555 miles containing 1,026 million cubic yards are located along the Mississippi River, and the remainder along major tributaries (lower Arkansas and Red Rivers) and outlets. Work was continued on the following additional project features:

Table 15. Project Features on Which Construction Was Continued During Fiscal Year 1960

Project features	Nature of project feature
Mississippi River improvements.....	Levees, revetments, dikes, dredging and wave wash protection.
Memphis Harbor (Tennessee Chute), Tenn.	Ensley Levee.
Vicksburg Harbor, Miss.....	Harbor channel, approach navigation channel and industrial fill.
Baton Rouge Harbor (Devils Swamp), La.	Barge channel and turning basin.
Lake Pontchartrain, La.....	Levee enlargement, shaping and wave wash protection.
Atchafalaya Basin, La.....	Levees, revetment, channel improvement by dredging, and highway and railway relocations.
Old River, La.....	Navigation lock, levees, and outflow channel.
Yazoo Basin, Miss.....	Lower auxiliary channel, leveed floodway and landside drainage ditches—mile 20.7 to mile 24.9.
Lower Arkansas River, Ark. (North Bank).	Enlargement and construction of levees and drainage structures.
Lower White River, Ark.....	White River backwater levee system, enlargement of levee.
St. Francis Basin, Ark. and Mo.....	Floodways, levees, interior drainage channels, highway and railroad crossings.

During the year, work was initiated on the following project features.

Table 16. Project Features on Which Construction Was Initiated During Fiscal Year 1960

Project features	Date initiated	Nature of project feature
Old River, La.-----	Jun 60--	Dredging inflow channel.
Tensas Basin, La.-----	Aug 59--	Bayou Macon, La., channel improvement, Reach 1.
	Jun 60--	Bayou Macon, La., channel improvement, Reach 2.
Yazoo Basin, Miss.-----	Oct 59--	East bank levee enlargement—Techeva Creek.
	Jul 59--	Humphreys County bridge and roads—Lower Auxiliary channel.
	Aug 59--	Illinois Central RR. bridge over Lower Auxiliary channel.
	Jul 59--	U.S. Highways Nos. 82 and 49—E twin bridges, Greenwood Cutoff.
	Oct 59--	Channel improvement, Quiver River, mile 16.15 to mile 30.43.
	Jun 60--	Channel improvement, Bogue Hasty, mile 0.0 to mile 6.5.
	Oct 59--	Two Leflore County bridges, Quiver River.
	Jun 60--	Channel improvement, McKinney Bayou, mile 2.18 to mile 5.74.

During the year, preconstruction planning was continued on Mississippi River levee enlargement, bank protection, and on alluvial valley levees and channel improvements under construction. Such planning was also initiated on the following additional work:

Table 17. Project Features on Which Preconstruction Planning Was Initiated During Fiscal Year 1960

Project feature	Nature of project feature
Mississippi River—Greenville Harbor, Miss.	Connecting channel and harbor channel improvement and industrial fill.

Incident to the construction of the project, the following features were maintained and operated during the year:

Table 18. Project Features on Which Maintenance and Operation Activities Were Conducted During Fiscal Year 1960

Project feature	Nature of project feature
Mississippi River-----	Channel improvement, levees, revetments, and wave wash protection.
Bonnet Carre Spillway, La-----	Levees, floodway, and control structure.
Atchafalaya Basin, La-----	Maintenance of levees and channels.
	Operation and maintenance:
	Locks:
	Bayou Sorrel.
	Bayou Boeuf.
	Berwick.
	Floodgates:
	Charenton.
	Calumet
	Bayou Courtableau.
	Drainage structures: Wax Lake Outlet and numerous smaller drainage structures.
Morganza Floodway, La-----	Maintenance of floodway and control structure.
Lower Red River, La-----	Levees and bank protection works.
Yazoo Basin, Miss.:	
Yazoo Basin headwater, Miss-----	Levees and channels.
Greenwood, Miss-----	Local protection—levees, storm water pumping station and drainage structures.
Yazoo City, Miss-----	Local protection—levees, storm water and sanitary sewage pumping stations and drainage structures.
Sardis Reservoir, Miss-----	Reservoir.
Arkabutla Reservoir, Miss-----	Do.
Enid Reservoir, Miss-----	Do.
Grenada Reservoir, Miss-----	Do.
St. Francis Basin, Mo.: Wapapello Reservoir-----	Do.

Floods. No major flooding occurred on the Mississippi River from Cairo, Ill., to its mouth during fiscal year 1960. Highest stages occurred in April at Cairo, Ill., and Memphis, Tenn., and were 3.3 feet and 0.5 foot, respectively, above flood stage. Highest stages at Arkansas City, Ark., Red River Landing, La., and New Orleans (Carrollton), La., were 12 feet, 5.5 feet, and 5 feet, respectively, below flood stage. Red River crested at Alexandria, La., in January, at a stage of 22.1 feet approximately 10 feet below flood stage. Crest stages occurred in

in the upper Ouachita River in December and were 4 feet and 6 feet above flood stage at Arkadelphia, Ark., and Camden, Ark., respectively. It is estimated that the operation of Blakely Mountain Reservoir lowered the crest stage by 3.3 feet and 2.5 feet at Arkadelphia and Camden, respectively. Crest stages occurred on the lower Ouachita River in March and were about 8 feet below flood stage at Monroe, La., and Jonesville, La. Crest stages in the lower Boeuf-Tensas Basin occurred in March and were 9–12 feet below flood stage. A moderate rise on the Coldwater-Tallahatchie-Yazoo Rivers began in December, and crested in March when flood stage was reached at Swan Lake, Miss., and a stage 5.5 feet below flood stage was reached at Greenwood, Miss. Operation of flood control works effected a reduction in stage averaging about 6 feet on the Coldwater River, 5 feet on the Tallahatchie and about 4 feet at Greenwood, Miss.

The lower Arkansas River crested at Pine Bluff, Ark., in October 1959 at a stage of 25 feet, about 1 foot above flood stage.

The St. Francis River crested at St. Francis, Ark., in December at a stage of 18.5 feet, about 0.5 foot under flood stage. Operation of flood control works on the St. Francis River effected stage reductions above Lake City, Ark., ranging from 1 to 4 feet. The lower White River crested at Clarendon, Ark., in June at a stage of 27.6 feet, about 3 feet above flood stage, which was materially reduced by operation of upstream reservoirs. Crest stages on the West Tennessee tributaries occurred in March as follows: Obion River at Bogota, Tenn., 15.1 feet; North Fork of Forked Deer River at Dyersburg, Tenn., 21 feet; Hatchie River at Rialto, Tenn., 13.7 feet. These stages were 2.1 feet, 7.0 feet and 1.7 feet, respectively, above flood stage. Wolf River crested in March at 13 feet at Raleigh, Tenn., about a foot above flood stage. Loosahatchie River crested in March at 21.5 feet at Brunswick, Tenn., about flood stage.

Condition of overall project. At the end of the fiscal year, construction on the project as a whole between Cape Girardeau, Mo., and the Gulf of Mexico was about 65 percent complete. Work on the main stem is sufficiently well advanced to afford a high degree of protection from Mississippi River flood overflow to most of the alluvial valley, except in the unprotected backwater areas. A total of 1,488 miles of mainline levees has been enlarged to project grade and section. The bank stabilization program has progressed steadily during recent years through construction of bank revetment, dikes, and corrective dredging, to prevent the river from regaining its former length due to its natural tendency to meander. A long-range plan is being developed to bring about and maintain the desired alinement of the river between Baton Rouge, La., and Cairo, Ill.

At the end of the fiscal year, there were 431 miles of operative revetment and 80,100 linear feet of effective dikes on the Mississippi River below Cairo, Ill. Project work on the lower Arkansas River consists of 20.8 miles of revetment and 67,200 linear feet of dikes. Project work on lower Red River and Atchafalaya Rivers consists of 5.2 miles of revetment and 16,017 linear feet of dikes. The Arkabutla, Sardis, Enid, and Grenada Reservoirs in the Yazoo Basin, Miss., and the Wappapello Reservoir in the St. Francis Basin, Mo., have been completed. Other authorized improvements in the alluvial valley, including levees, channel improvements, and supplementary drainage works, are under construction. A total of 1,197 miles of secondary levees, containing 376 million cubic yards, is in place. The Bonnet Carre, Morganza, West Atchafalaya, and Atchafalaya floodways are in a useful operational status, and with the Atchafalaya River, will permit the diversion of 1,750,000 cubic feet per second of project flood discharge to the Gulf of Mexico, leaving 1,250,000 cubic feet per second to pass down the main stem at New Orleans, La. On completion, the Old River control structure will prevent the steadily enlarging channels of the Old and Atchafalaya Rivers from capturing the flow of the Mississippi River. The total benefits that have accrued since the adoption of the project are estimated at more than \$6 billion, which amounts to approximately \$6 in benefits for every dollar of project funds so far expended.

The authorized Mississippi River and tributaries project, as amended, provides for a 12- by 300-foot navigation channel on the Mississippi River between Baton Rouge, La., and Cairo, Ill., and a 12- by 125-foot navigation channel on the Old and Atchafalaya Rivers between the Mississippi River and Morgan City, La. The Mississippi River channel between Baton Rouge and Cairo was maintained to provide a dependable 9-foot depth for navigation, except at the following crossings: Island 20 (831 AHP), September 22-23, 1959, 8.5 feet; Blue Grass Towhead (823 AHP), September 23-26, 1959, 8.5 feet; Wardlow Pocket (808 AHP), September 22-26, 1959, 8.5 feet; Golddust (795 AHP), September 22-24, 1959, 8.5 feet; Stonewall (775 AHP), September 21-24, 1959, 8.5 feet; Hatchie Island Bar (773 AHP), September 20-22, 1959, 7 feet; Fletcher Mayes (701 AHP), September 24-27, 1959, 8.5 feet; and Reserve (480 AHP), September 20-22, 1959, 8 feet. Commensurably greater depths were available during the high water season. The Atchafalaya River channel through Grand and Six Mile Lakes between the Mississippi River and Morgan City, La., was maintained to provide adequate depth throughout the year.

Comprehensive review of Mississippi River and tributaries project.

The comprehensive review report by the Mississippi River Commission, authorized June 12, 1954, was submitted to Chief of Engineers on December 18, 1959. The report and tributary annexes present surveys of the main stem and the off-main-stem areas in the alluvial valley. It covers the adequacy of authorized plans, the cost of completing authorized features of the project, and proposed plans of project modification and extension requested by local interests. The proposed plans of improvement are coordinated with the plans of other Federal and State agencies for the development and conservation of water resources in the alluvial valley. At the request of the president, Mississippi River Commission, the U.S. Department of Agriculture assisted in furnishing economic data on agriculture and timber development, and farm drainage. The Fish and Wildlife Service of the U.S. Department of the Interior is submitting a report covering the coordination of proposed improvements with the conservation of fish and wildlife. A supplementary study to determine the benefits from upstream reservoirs in the relief of flood damage to lands, and the increase of low streamflow in the Mississippi River below the Missouri River, was continued and is nearing completion.

7. GENERAL OPERATIONS

Work done by contract. The Corps of Engineers for many years has consistently adhered to its policy of having construction work done by contractors wherever practicable. This past year was no exception to the policy. In fact, 95 percent of all construction work was performed by contract and only 5 percent by Government plant and hired labor. In recent years the amount of construction by hired labor has remained at this low percentage. A larger percentage of the maintenance work has been performed by hired labor. The hired labor work on construction projects has been limited to such types of operations as dredging in exposed harbor entrances by Government-owned hopper dredge, the construction of erosion-control and levee-revetment works, and grouting operations. The nature of such work does not readily lend itself to advertising and performance by contract.

Accident prevention. Injury rates continued stabilized at a low level. Chart III shows comparison of injury rates for Corps of Engineers' contractor employees with those for the construction industry. Also compared are injury rates for Corps of Engineers' employees with those for all employees of the Federal Government.

Fire prevention. Government property and equipment losses by fire were \$14,790, the lowest in many years.

DISABLING INJURY FREQUENCY RATE NUMBER OF DISABLING INJURIES PER MILLION MAN HOURS WORKED

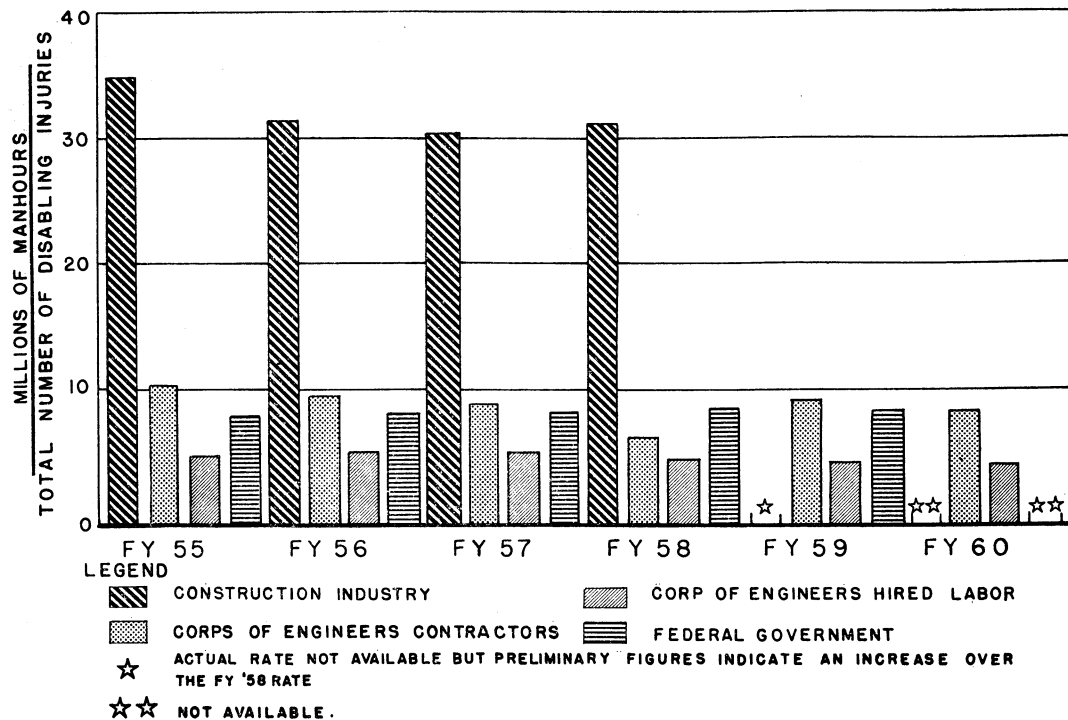


Chart III

CHAPTER IV

CURRENT PROJECT PLANNING AND DEVELOPMENT

1. PROGRAM POLICY MATTERS

The Corps of Engineers continued participation with other Federal agencies and with agencies of the various States in activities pertaining to the development of national water resource policies. In addition, various policies and procedures in use by the Corps of Engineers were reviewed, improved, and modified. The more important of these activities are discussed in the following paragraphs.

Interagency Committee on Water Resources. The Interagency Committee on Water Resources is composed of policy officials at the secretarial level of the Departments of Agriculture; Army; Commerce; Health, Education, and Welfare; Interior; and Labor; and the Federal Power Commission. The committee establishes means and procedures to promote coordination of the water and related land resources activities of the member agencies, undertakes resolution of inter-agency differences, suggests to the President changes in policy that would promote coordination and reduce differences, and reviews problems referred to it by field committees. Field committees have been set up for the Missouri, Columbia, Pacific Southwest, and Arkansas-White-Red Basins, and the New England area. The committee performed its regular activities principally through its subcommittees on hydrology, sedimentation, and evaluation standards.

Progress was made during the year in reaching mutual understandings relative to evaluation of fish and wildlife losses and benefits. The Subcommittee on Evaluation Standards proposed an interim procedure based on utilization of a schedule of unit values for specific types of recreational fish and wildlife use at projects and comparison with estimates of alternative costs for a check on project benefits or a limit on justifiable expenditures. Following the close of the fiscal year, the Interagency Committee adopted the Subcommittee's report on proposed interim schedule of values for recreational aspects of fish and wildlife as a basis for further study and for interim use by the participating agencies as an aid to judgment in preparing project reports pending further improvements in methods of evaluation.

Watershed protection and flood prevention. The Corps of Engineers and the Department of Agriculture continued to improve coordination

of plans for small headwater reservoirs developed under the authorities of Public Law 566 (the Watershed Protection and Flood Prevention Act of 1954, as amended) with the plans prepared under the flood control acts. The Department of Agriculture has continued cooperative studies in the Delaware, Potomac, and Cape Fear River Basins, all of which were initiated prior to fiscal year 1960. These studies are expected to lead to the development of comprehensive and coordinated basinwide plans.

During fiscal year 1960 the Corps of Engineers reviewed 59 Public Law 566 plans and submitted comments thereon to the Secretary of the Army as a basis for the views and recommendations which he submits to the Secretary of Agriculture, pursuant to the provisions of Public Law 566. This increases to 192 the total number of watershed work plans reviewed by the Corps of Engineers since initiation of the Public Law 566 program.

Supplement to land acquisition policy. A supplement to the Department of the Interior-Department of the Army joint policy for land acquisition was issued to assure that the limited land areas needed to protect and preserve recreation and fish and wildlife potentials will be defined at reservoir projects. The supplement provides that when acquisition of lands is justified for recreation and fish and wildlife purposes, such lands will be shown separately in reports of project plans to insure that Congress has full information upon which to base a decision as to their inclusion in project authorization. The primary responsibility of State and local governmental agencies for providing recreational facilities for their people is recognized, but the Federal Government should cooperate in protecting and preserving recreational opportunities in connection with the construction, maintenance, and operation of Federal navigation, flood control, irrigation, or multiple-purpose reservoir projects.

Aquatic plant control. In accordance with the provisions of Public Law 85-500, policy agreements for local participation were reached for work in North Carolina, South Carolina, Georgia, Florida, and Louisiana. New policies are being developed on the basis of research on control methods by the Agricultural Research Service, Fish and Wildlife Service, Public Health Service, Auburn University, and Southwestern Institute.

Remedial works (relocations). Section 111 of the River and Harbor Act approved July 3, 1958 (Public Law 85-500), provides that a governmental structure or facility adversely affected by construction of a project may be altered or paid for with project funds.

Section 207(b) of Public Law 86-645 approved July 14, 1960, provides that for such water resources projects, under construction or to

be constructed, when the taking by the Federal Government of an existing public road necessitates replacement, the Chief of Engineers is authorized to construct such substitute roads to design standards comparable to those of the State in which the road is located.

Policy instructions concerning interpretation and application of the above legislation have been furnished the district and division engineers.

Interagency Committee on Cost Allocation and Accounting. This Committee was established in 1957 to provide a means of developing acceptable procedures and resolving problems of mutual concern relating to the allocation of costs and financial practices for Federal power projects. It is comprised of representatives of the Corps of Engineers, Department of the Interior, Federal Power Commission, and General Accounting Office. Six meetings were held, during which agreement was reached on allocation of costs for the Jim Woodruff, Buford, Cheatham, and Old Hickory projects. Procedures were devised for the interchange of information on revenues for projects in the Southeastern States and the handling of such revenues in project accounts.

International boundary water studies. Pursuant to the treaty of 1909 between the United States and Great Britain relating to boundary waters between the United States and Canada, the International Joint Commission was organized in 1911. In general, the Commission exercises jurisdiction over matters involving the use, obstruction, or diversion of boundary waters between the two countries. When such matters are assigned by the respective governments to the Commission for investigation and/or resolution, they are generally designated as "References." The Commission is empowered to utilize the services of Government agencies in both countries to assist the Commission in carrying out the terms of such references. During the past year the Corps of Engineers has continued its active participation as a member of the following international engineering boards established by the Commission.

International Columbia River Engineering Board. This Board was appointed by the Commission in April 1944 to investigate and report upon the feasibility of further development of the water resources of the Columbia River Basin, a region encompassing approximately 260,000 square miles located in the Pacific Northwest area of the United States and including a portion of the Province of British Columbia, Canada. To undertake the extensive field investigations and associated studies required, an International Engineering Committee, composed of Federal, State, and Provincial representatives, was established by the International Engineering Board. The main

volume of the Engineering Board's report, entitled "Water Resources of the Columbia River Basin," was transmitted to the Commission in March 1959. The last volume of the six appendixes, containing technical data, to the Board's report was forwarded to the Commission in June 1960. For the past several years the Chief of Engineers has served as Chairman of the U.S. Section of the Board.

International Souris-Red Rivers Engineering Board. The Board was established by the Commission in April 1948 to conduct investigations and report upon the water requirements and further uses thereof, including apportionment of streams crossing the international boundary, in an area extending from the Milk River Basin easterly to include the drainage basin of the Red River of the North. Being a semiarid region with limited water sources, the studies to date have been mainly concerned with better uses of existing sources for irrigation and domestic water supply. The Board has filed several interim reports with the Commission. In reporting specifically on the Souris River, the Board concluded that the natural flow at both border crossings is inadequate to supply the present and anticipated water demands and recommended that the available water supplies be allocated to provide equitable distribution. The Board is presently concerned with a study of the Pembina River to determine whether a coordinated plan of development by both countries is feasible.

International Passamaquoddy Engineering Board. In accordance with Public Law 401, 84th Congress, and the Boundary Waters Treaty of 1909, Canada and the United States in 1956 directed the International Joint Commission to investigate the feasibility of developing the tides of Passamaquoddy and Cobscook Bays in New Brunswick and Maine for power. An International Passamaquoddy Engineering Board was one of two boards established by the Commission to make the study. The Engineering Board appointed an Engineering Committee to conduct the necessary studies. The Division Engineer, New England Division, served as chairman of the U.S. Section of the Engineering Committee. On October 1, 1959, the Engineering Board submitted its report, "Investigation of the International Passamaquoddy Tidal Power Project," to the International Joint Commission.

International St. Croix River Engineering Board. This Board was appointed by the Commission in September 1955 to determine whether further development of the water resources of the St. Croix River would be practicable and in the public interest from the point of view of the two Governments in the use, conservation, and regulation of the waters of the basin. The St. Croix River is a boundary stream with a drainage basin area of approximately 1,600 square miles located in the eastern portion of Maine and the southwestern portion of New

Brunswick. The report of the Engineering Board was submitted to the International Joint Commission in September 1957. At a public hearing held on June 27, 1958, in Calais, Maine, the Commission obtained the views of local interests regarding the measures proposed by the Engineering Board for improvement of the regimen of the river. In October 1959 the Commission filed its report with the two Governments. In brief, the Commission's report recommended the establishment of maximum high water levels in the headwater storage lakes, abatement of existing and prevention of future pollution, restoration of anadromous fish runs, and that redevelopment of the Milltown, New Brunswick, site for hydroelectric power be undertaken by Canadian interests. The Commission's report is awaiting further action by the Governments of Canada and the United States.

International Saint John River Engineering Board. As a result of a reference received from the two Governments in September 1950, the International Joint Commission appointed the International Saint John River Engineering Board in October 1950 to undertake field investigations to determine whether the waters of the Saint John River system could be more beneficially conserved and regulated, and to recommend what projects in the Saint John River basin, above Grand Falls, New Brunswick, would be practical in the public interest. The scope of the original reference was enlarged in July 1952 to include all of the Saint John River system above tide water near Fredericton, New Brunswick. The Saint John River Basin is located in northern Maine and the adjacent areas of the provinces of Quebec and New Brunswick. The river and two of its tributaries form part of the international boundary between Canada and the United States. It has a drainage area of 21,600 square miles and is one of the largest rivers in North America to drain into the Atlantic Ocean. In April 1953 the Engineering Board transmitted to the Commission an interim report entitled "Water Resources of the Saint John River Basin." The Commission's interim report, dated January 27, 1954, was transmitted to the two Governments in April 1954 and contained the recommendation that the interim report be approved by the Governments as a basis for continuing study by the Commission and parties in both countries directly interested in water resource development in the Saint John River Basin. Further reports or a final report will be submitted by the Commission when studies commensurate with the need for development have been completed. In the meantime the interim report, receipt of which was acknowledged by the U.S. Government in October 1954, will serve as a guide when further developments of the water resources of the Saint John River Basin are considered.

2. OMNIBUS RIVER AND HARBOR AND FLOOD CONTROL ACT OF 1960

H.R. 7634, 86th Congress, the Omnibus River and Harbor and Flood Control Act, was signed by the President on July 14, 1960, shortly after the end of the fiscal year. The act authorizes works with a current estimated cost of \$1,445,694,300, of which \$1,385,694,300 is for work by the Corps of Engineers.

The Corps' work is broken down as follows:

Title I. Rivers and Harbors:

Navigation projects or project modifications	\$203, 519, 300
Beach erosion control projects	22, 345, 800
Monetary authorization (Barkley Dam, Ky.)	146, 000, 000
Total title I	371, 865, 100

Title II. Flood Control:

New projects or project modifications	277, 589, 200
Increased basin authorizations	736, 240, 000
Total title II	1, 013, 829, 200

Grand total	1, 385, 694, 300
--------------------------	-------------------------

The act (sec. 109) also authorizes 19 navigation and (sec. 208) 11 flood control surveys to be carried out in 13 States.

Section 107 of the act authorizes the construction, when found advisable by the Chief of Engineers, of small navigation projects for which the Federal share does not exceed \$200,000. There is already similar authority for small flood control projects costing not over \$400,000. Section 206 of the act empowers the Chief of Engineers, upon the request of State or local governments, to provide flood plain information to aid them in planning and regulating the use of such areas and to ameliorate future flood hazards.

3. SURVEY PROGRAM

The Public Works Committees of Congress adopted 124 resolutions requesting review of previous reports on proposed improvements.

Current survey program. Efforts to improve rapidity of reporting and the format of reports continued. Interagency coordination continued. Several special studies that are elements of the survey program are discussed in subsequent paragraphs.

Developments in survey procedures. Preparation of engineering manuals on survey report procedures was continued. Manuals and instructions on benefit evaluation in beach erosion control and on economic base studies were issued during the year.

Table 19. Reports Processed During Fiscal Year 1960 and Status at End of Year

Reports transmitted to—	Number
Congress.....	78
Bureau of the Budget.....	69
State and Federal agencies.....	78
River and harbor and beach erosion boards.....	89
Total actions.....	314
Status as of June 30, 1960	
Favorable reports before Congress.....	108
Reports in process in Office, Chief of Engineers.....	62
Active reports in field offices.....	256
Special studies active in field offices.....	12
Inactive reports in field offices.....	731
Special studies inactive in field offices.....	1
Total reports.....	1, 170

Columbia River and tributaries review. The report of the Division Engineer covers the entire field of water resource use, with studies of main-stem flood control, navigation, and power development. Coordination has been maintained with Federal, State, and local agencies. The Board of Engineers for Rivers and Harbors prepared its report to the Chief of Engineers. Preparation of the report of the Chief of Engineers was in progress.

Delaware River comprehensive review. A comprehensive review investigation of the Delaware River was continued. A full and continuing exchange of information and views is being accomplished by a coordinating committee with Federal, State, and local representation.

Comprehensive survey of Great Lakes harbors. The St. Lawrence Seaway and the Great Lakes connecting channels project will provide a waterway with minimum depth of 27 feet throughout the Great Lakes system, connecting with the Atlantic Ocean. Traffic into the Great Lakes through the deep-draft St. Lawrence Seaway, as well as the deeper draft traffic expected from improvement of connecting channels, necessitates reexamination of harbors on the Great Lakes. Such studies have been authorized. A comprehensive traffic study of waterborne commerce that will use the seaway and connecting channels is under way and scheduled for completion in June 1961. A total of 26 public hearings have been held. More than 50 harbors will be considered. Interim reports are being prepared on 35 harbors, and the remaining harbors will be covered in the final report sched-

uled for completion in September 1961. Reports on 17 harbors have been completed and submitted to Congress. These harbors are included in an omnibus bill which passed the House of Representatives and the Senate before the end of the fiscal year. Interim reports on 18 harbors are scheduled for completion by reporting officers during fiscal year 1961.

Hudson River siltation study. This authorized study will determine what improvements are necessary and feasible to lessen shoaling in pier slips along the Hudson River and the Federal channel in the vicinity of Edgewater, N.J. Movement of freight and docking of passenger liners are affected adversely by siltation. The investigations were continued and model studies are underway.

Hurricane flood protection study. Hurricanes of recent years have caused heavy loss of life and unprecedented damage to property. Public Law 71, 84th Congress, authorized study of the coastal and tidal areas along the eastern and southern seaboard to secure data on hurricanes, methods of forecasting their paths, improving warnings, and preventing loss of life and property. This study, being made in cooperation with Federal and State agencies, was continued during the fiscal year. Initial appraisals have been completed. Interim reports on some 40 areas were in progress.

Ohio River comprehensive review. An authorized comprehensive review of the Ohio River and tributaries has the objective of developing a program to serve the needs of the area. Coordination is being maintained with interested Federal, State, and local agencies. Studies of floods and projects were continued.

Potomac River comprehensive review. An authorized comprehensive review of the Potomac River and tributaries was continued. The objective of this review is development of a comprehensive, basin-wide, water resource program. Attention to water supply and stream pollution comprises an important part of the study. Coordination is being maintained with Federal, State, and local agencies.

Survey of the San Francisco Bay area. An authorized comprehensive survey of the San Francisco Bay area was in progress. The study will include navigation requirements, flood control, reclamation of marginal lands, water supply, salt water intrusion, sedimentation, and other water problems. The possibility of using dikes or barriers across the northern and southern portions of the bay for fresh water impoundment, and as causeways, is being investigated. Model studies are being used. Coordination is being maintained with State and local interests. The economic base survey of the San Francisco Bay area made by the Department of Commerce for the Corps of Engineers has been published.

Mississippi River and tributaries project review. A comprehensive review of the project for flood control on the Mississippi River in the alluvial valley and for its improvement from the Head of Passes to Cape Girardeau, Mo., published in House Document 359, 77th Congress, was authorized June 12, 1954. This study involves reexamination of existing plans that have evolved over a period of more than 30 years to determine their adequacy and the need for and economic justification of any extensions or modifications of the authorized project. During fiscal year 1960, field and office studies were essentially completed, and review of the report was in progress in the Office, Chief of Engineers.

4. BOARD OF ENGINEERS FOR RIVERS AND HARBORS

The Board held six meetings of 1 to 2 days' duration, and also one public hearing in and one outside of Washington, D.C. The Board considered 70 reports, acting favorably on 45 and unfavorably on 22, and deferred action on 3. The Board recommended authorization of projects estimated to cost \$620 million, of which \$547 million is the estimated cost to the United States, and \$73 million the cost to local interests.

5. BEACH EROSION BOARD

This Board completed action on seven beach erosion control studies in cooperation with local public agencies, and assisted State agencies in setting up a study program for seven new cooperative studies and an addition to a continuing study, as listed below.

LIST OF BEACH EROSION CONTROL COOPERATIVE STUDIES COMPLETED AND APPLICATIONS APPROVED

Cooperatives Studies Completed During Year

San Diego County, Calif.

Orange County (Newport Bay to San Mateo Creek), Calif.

Cape Cod Canal to Provincetown, Mass.

Wessagusset Beach, Weymouth, Mass.

Michigan State line to Marblehead, Ohio

Delaware Bay Shore of New Jersey (Cape May Canal to Maurice River)

Presque Isle Peninsula, Erie, Pa.

Applications for Cooperative Studies Approved During Year

Bakers Haulover and vicinity, Fla.

Broward County, Fla.

Evanston, Ill. (review)

Haloilas Beach, Oahu, Hawaii

Hunting Island, S.C. (review)

Ocracoke Inlet to Cape Lookout, N.C.

Waikiki Beach, Oahu, Hawaii (review)

Eleven reports, including one hurricane survey report, were reviewed for probable effects of navigation improvements on the adjacent shorelines. In addition, hurricane protection was considered in the combined report, Atlantic coast of Long Island, N.Y., and four other hurricane survey reports and one flood control design memorandum were reviewed.

Results of the research investigations conducted by the Board are made available to the using public in the form of publications. During the year, three technical memoranda and two miscellaneous papers were issued.

6. ADVANCE ENGINEERING AND DESIGN

During the preliminary phase of preparing authorized projects for construction, features thereof are developed, firm estimates of cost are prepared, orderly construction schedules are worked out, and necessary detailed information is readied for coordination with local interests and other agencies. A backlog of projects ready for initiation of construction is in preparation to allow inclusion in the civil works construction program as the national budgetary policy permits, at the same time assuring the development of a sound and well-balanced program consistent with the Nation's needs.

With \$10,008,600 made available, together with funds carried over from prior years, planning was prosecuted on 126 projects, consisting of 20 navigation, 98 flood control, and 8 multiple-purpose projects. Planning on 26 of these projects was advanced to the stage where construction could be readily initiated. Funds in the amount of \$10,402,899, representing approximately 81 percent of the total available, were obligated.

The Corps of Engineers continued its program of investigating the means of improving design and construction procedures. The accomplishments and economies effected in this field of activity are set forth in the discussion of the civil works investigations program in chapter VI.

7. COLLECTION AND STUDY OF BASIC DATA

The collection and study of basic data are indispensable to the planning, design, and operation of Corps' river-basin projects for the development of the Nation's water resources. This item includes those cooperative activities performed by other Federal agencies at the request of the Corps of Engineers and for which funds are provided by this agency for the basic programs of observing, compiling, reporting, and publishing data on streamflow, rainfall, and fish and wildlife resources. In addition to the work requested of other agencies, field offices of the Corps of Engineers conduct activities related to the study

and control of international streams which affect the United States and Canada. A description of each of these activities during fiscal year 1960 is presented below:

a. Cooperative programs with U.S. Weather Bureau.

- (1) Operation of a network of rainfall gages, primarily of the continuous recording type, known as the Hydroclimatic Network, was continued by the Weather Bureau at the request of the Corps of Engineers. Funds in the amount of \$444,000 were transferred to the Weather Bureau for continued operation of this network during fiscal year 1960. A total of 2,736 stations (2,284 recording and 452 nonrecording) were in operation in the network on June 30, 1960. Data from these stations are published monthly by the Weather Bureau in "Hourly Precipitation Data."
- (2) The Hydrometeorological Section of the Weather Bureau was continued during the year, at the request of the Corps of Engineers, to review the meteorological aspects of the storm study program and to continue the development of theoretical concepts and practical techniques of estimating probable maximum precipitation for use in engineering design. Funds in the amount of \$112,750 were made available to the Weather Bureau to finance continued operation of this Section during fiscal year 1960. Accomplishments during this year include revision of a draft report on comprehensive analysis of probable maximum precipitation in California; publication of Hydrometeorological Report No. 35, "Meteorology of Hypothetical Flood Sequences in the Mississippi River Basin"; estimates of probable maximum precipitation for 16 project areas; publication of Weather Bureau Technical Paper No. 15, "Maximum Station Precipitation for 1, 2, 6, 12 and 24 Hours," for States of Texas and Arkansas; review of several storm studies and other investigations involving meteorological phases of engineering problems.
- (3) The River and Rainfall Reporting Networks, currently totaling 40 in number, were also continued at the request of the Corps of Engineers in order that frequent reports of river stage and rainfall data would be available. These data are required by District Engineers for operation of river improvement projects and for flood-forecasting purposes. Funds in the amount of \$115,480 were transferred to the Weather Bureau for operation of this program during fiscal year 1960.

b. Stream gaging program with the U.S. Geological Survey. The Geological Survey was requested to continue the cooperative program of constructing, maintaining, and operating stream-gaging stations

required by the Corps of Engineers in carrying out assigned water resources investigations. A total of \$1,481,400 was transferred to the Geological Survey for operation of approximately 1,800 stations under this program during fiscal year 1960. Data obtained from these stations are published by the Geological Survey in the series of Annual Water Supply Papers.

c. Studies by U.S. Fish and Wildlife Service. Funds were made available to the Fish and Wildlife Service for continuation of study of the effects of Corps of Engineers projects upon fish and wildlife resources as a basis for determining the means and measures needed to prevent loss or damage to fish and wildlife resources or that may be desired by the Federal and State fish and wildlife agencies for enhancement of such resources, in accordance with the Fish and Wildlife Coordination Act, Public Law 85-624. A total of \$50,000 was transferred to the Fish and Wildlife Service from appropriations for "General Investigations of the Corps of Engineers." Data from these studies and recommendations by the Service are incorporated in Survey Reports of the Corps submitted to Congress.

d. International water studies. In order to carry out U.S. obligations under international agreement, several divisions and districts of the Corps of Engineers, having jurisdiction over areas bordering Canada, participate in a number of engineering and control boards functioning under the International Joint Commission for the purpose of controlling international streams. Funds appropriated for this purpose are made available to several Corps offices for this work. A detailed report on the various boards will be found in volume 2 under "Miscellaneous Civil Works, International Boundary Waters."

CHAPTER V

FUNDING TRENDS

1. FUNDS AVAILABLE FOR WORK

Fiscal year 1960 funds appropriated for civil works activities of the Corps of Engineers amounted to \$872,637,123. Individual appropriations are detailed in table 20. Status of the funds advanced by local interests for navigation and flood-control improvements is shown in table 21.

Table 20. Appropriations, Fiscal Year 1960

The funds with which the works for the maintenance and improvement of rivers and harbors and flood control were prosecuted during the fiscal year were derived from unexpended balances of prior appropriations and from the following appropriations acts, and by transfer from other departments:

Appropriation title	Date of act	Amount
PUBLIC WORKS APPROPRIATION ACT, 1960:	Sept. 10, 1959	
Flood Control, Mississippi River and Tributaries.	-----	\$53, 068, 512. 00
General Investigations, Corps of Engineers, Civil.	-----	8, 981, 250. 00
Construction, General, Corps of Engineers, Civil.	-----	561, 356, 247. 00
Operation and Maintenance, General, Corps of Engineers, Civil.	-----	96, 934, 950. 00
General Expenses, Corps of Engineers, Civil, 1960.	-----	10, 324, 000. 00
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1960.	-----	33, 000. 00
Total	-----	730, 697, 959. 00
JOINT RESOLUTION:	July 1, 1959	
Flood Control, Mississippi River and Tributaries.	-----	8, 000, 000. 00
General Investigations, Corps of Engineers, Civil.	-----	750, 000. 00
Construction, General, Corps of Engineers, Civil.	-----	50, 000, 000. 00
Operation and Maintenance, General, Corps of Engineers, Civil.	-----	9, 000, 000. 00
General Expenses, Corps of Engineers, Civil, 1960.	-----	1, 000, 000. 00
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1960.	-----	3, 000. 00
Total	-----	68, 753, 000. 00

Table 20. Appropriations, Fiscal Year 1960—Continued

Appropriation title	Date of act	Amount
JOINT RESOLUTION:	Aug. 3, 1959	
Flood Control, Mississippi River and Tributaries.	-----	\$8, 000, 000. 00
General Investigations, Corps of Engineers, Civil.	-----	750, 000. 00
Construction, General, Corps of Engineers, Civil.	-----	50, 000, 000. 00
Operation and Maintenance, General, Corps of Engineers, Civil.	-----	9, 000, 000. 00
General Expenses, Corps of Engineers, Civil, 1960.	-----	1, 000, 000. 00
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1960.	-----	3, 000. 00
Total -----	-----	68, 753, 000. 00
SECOND SUPPLEMENTAL APPROPRIATION ACT, 1960:	Apr. 13, 1960	
Operation and Maintenance, General, Corps of Engineers, Civil.	-----	2, 750, 000. 00
SPECIAL FUNDS:	<i>Treasury Warrant No.</i>	
Hydraulic Mining in California, Debris Fund.	601-96-5-----	18, 000. 00
Payments to States, Flood Control Act June 28, 1938, as Amended.	597-96-4----- 880-96-8-----	1, 511, 387. 44
Maintenance and Operation of Dams and Other Improvements to Navigable Waters (Credits to Accounts from Licenses under Federal Water Power Act, Aug. 26, 1935).	918-96-10-----	153, 777. 30
Total -----	-----	1, 683, 164. 74
TRUST FUNDS (CONTRIBUTIONS AND ADVANCES):		
Rivers and Harbors Contributed Funds.	Various-----	12, 173, 544. 07
FUNDS TRANSFERRED FROM OTHER DEPARTMENTS:		
Disaster Relief, Executive Office of the President (transfer to Corps of Engineers, Civil).	-----do-----	¹ — 75, 717. 28

See footnote at end of table.

Table 20. Appropriations, Fiscal Year 1960—Continued

Appropriation title	Date of act	Amount
FUNDS TRANSFERED FROM OTHER DEPARTMENTS—Con.		
Salaries and Expenses, Office of Civil and Defense Mobilization (transfer to Corps of Engineers, Civil), 1958 and 1959.	Various-----	¹ —\$363. 67
Technical Cooperation, General, Executive (transfer to Corps of Engineers, Civil), 1958.	-----do-----	¹ —32, 200. 55
Technical Cooperation, General, Executive (transfer to Corps of Engineers, Civil), 1959.	-----do-----	42, 200. 55
Technical Cooperation, General, Executive (transfer to Corps of Engineers, Civil), 1960.	-----do-----	9, 600. 00
Defense Support, General, Executive (transfer to Corps of Engineers, Civil), 1958.	-----do-----	¹ —3, 844. 43
Defense Support, General, Executive (transfer to Corps of Engineers, Civil), 1959.	-----do-----	24, 039. 43
Construction and Rehabilitation, Bureau of Reclamation (transfer to Corps of Engineers, Civil).	-----do-----	320, 000. 00
Construction, Bureau of Indian Affairs (transfer to Corps of Engineers, Civil).	-----do-----	600, 000. 00
Passamaquoddy Tidal Power Survey (transfer to Corps of Engineers, Civil).	-----do-----	30, 471. 89
Salaries and Expenses, National Science Foundation (transfer to Corps of Engineers, Civil).	-----do-----	6, 600. 00
U.S. Dollar Advances from Foreign Governments, U.S. Educational Exchange Program, State (transfer to Corps of Engineers, Civil).	-----do-----	1, 600. 00
Capital Outlay, U.S. Soldiers' Home (transfer to Corps of Engineers, Civil).	-----do-----	5, 202, 700. 00
Capital Outlay, U.S. Soldiers' Home (transfer to Corps of Engineers, Civil).	-----do-----	¹ —407. 11
Total-----	-----do-----	6, 124, 678. 83
Grand total, all funds-----	-----do-----	890. 935. 346. 64

¹ Returned to originating agency.

Table 21. Advanced Funds

The following amounts have been advanced by local interests for river and harbor improvements under the provisions of Sec. II, River and Harbor Act, Mar. 3, 1925, and for flood control works under the provisions of the Act of Oct. 15, 1940, and are returnable to the same interests when necessary Government funds are available.

	District	Balance due from U.S. June 30, 1959	Amount received during fiscal year	Amount returned during fiscal year	Balance due from U.S. June 30, 1960
Selkirk—Shore Protection.	Buffalo-----	\$5, 000. 00	-----	-----	\$5, 000. 00
Imperial Beach, Calif.	Los Angeles--	32, 000. 00	-----	-----	32, 000. 00
Total rivers and harbors.	-----	37, 000. 00	-----	-----	37, 000. 00

2. ANNUAL APPROPRIATIONS

Chart IV indicates the fluctuation in annual appropriations since 1950 for civil works functions.

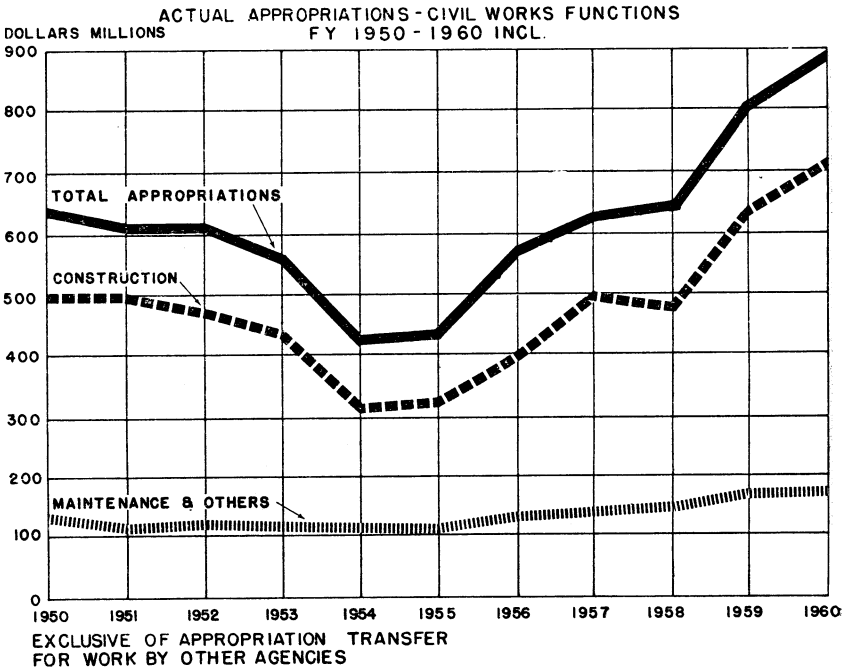


Chart IV

3. EXPENDITURES (COSTS)

During fiscal year 1960, expenditures (costs) amounted to \$873,184,055 on the civil works program. Of this amount, \$707,423,666 was for construction and \$165,760,389 for all other activities except those funded by contingencies, advances, and collections from local sources and transfers from other agencies. Chart V shows comparative expenditure (cost) data since 1953. Expenditures under each appropriation are listed in table 22.

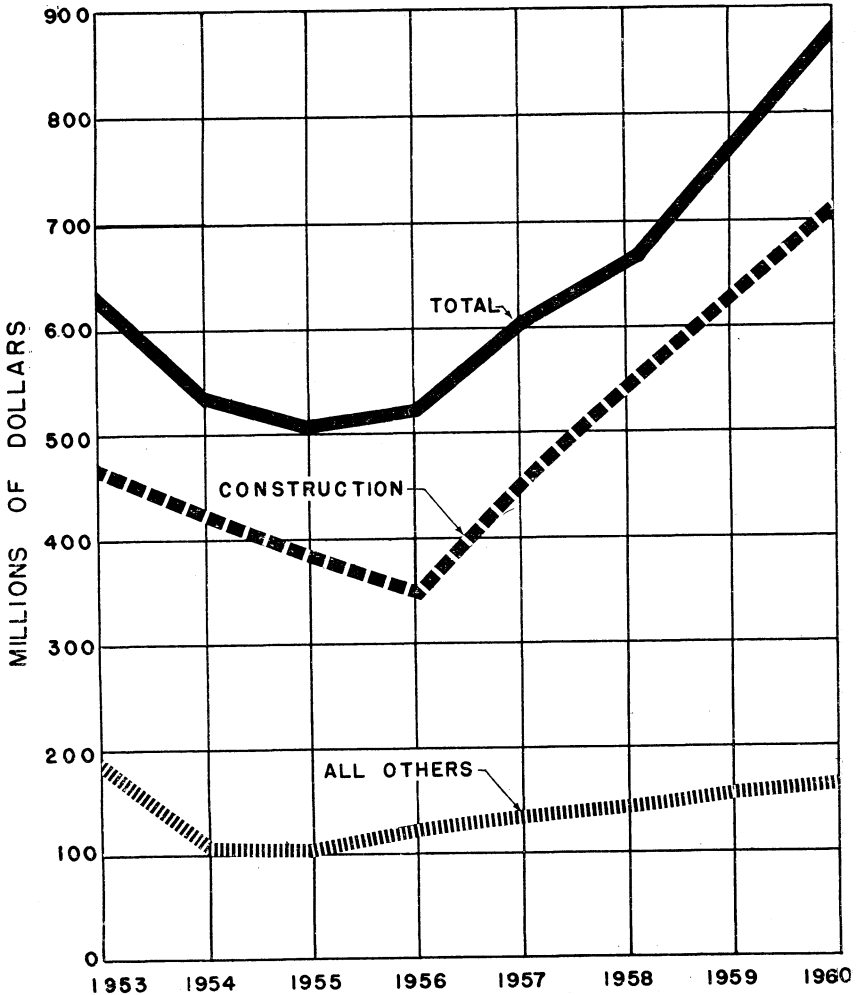
EXPENDITURES (COST) - CIVIL WORKS FUNCTIONS

Chart V

Table 22. *Accrued Expenditures, Fiscal Year 1960*

The total actually expended under the direction of the Chief of Engineers in connection with the maintenance and improvement of rivers and harbors, flood control, and other miscellaneous works during the fiscal year ended June 30, 1960, as follows:

Appropriation title	Amount
RIVERS AND HARBORS AND FLOOD CONTROL:	
Flood Control, Mississippi River and Tributaries.....	\$70,924,592.09
General Investigations, Corps of Engineers, Civil.....	10,830,549.61
Construction, General, Corps of Engineers, Civil.....	664,148,304.00
Operation and Maintenance, General, Corps of Engineers, Civil.....	113,541,170.75
General Expenses, Corps of Engineers, Civil, Prior Years..	¹ —2,093.62
General Expenses, Corps of Engineers, Civil, 1958.....	¹ —1,745.97
General Expenses, Corps of Engineers, Civil, 1958 and 1959.....	50,105.74
General Expenses, Corps of Engineers, Civil, 1960.....	12,228,927.46
Maintenance and Operation of Dams and Other Improvements to Navigable Waters.....	152,375.93
Total Rivers and Harbors and Flood Control.....	871,872,185.99
MISCELLANEOUS APPROPRIATIONS:	
Niagara Remedial Works.....	² —177,187.71
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1958 and 1959.....	¹ —409.34
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1960.....	13,134.83
Hydraulic Mining in California, Civil.....	21,997.92
Payments to States, Flood Control Act of 1954.....	1,454,333.12
Total Miscellaneous Appropriations.....	1,311,868.82
CONTRIBUTED AND ADVANCED FUNDS:	
Rivers and Harbors Contributed Funds.....	11,813,937.03
Rivers and Harbors Advanced Funds.....	25,600.23
Total Contributed and Advanced Funds.....	11,839,537.26
Total Appropriated and Contributed Funds.....	885,023,592.07
TRANSFERS FROM OTHER DEPARTMENTS:	
Disaster Relief, Executive Office of the President (Transfer to Corps of Engineers, Civil).....	61,964.22
Salaries and Expenses, Office of Civil and Defense Mobilization (Transfer to Corps of Engineers, Civil), 1958 and 1959.....	.02
Technical Cooperation, General, Executive (Transfer to Corps of Engineers, Civil), 1958.....	³ —1,176.82
Technical Cooperation, General, Executive (Transfer to Corps of Engineers, Civil), 1959.....	38,144.97

See footnotes at end of table.

Table 22. *Accrued Expenditures, Fiscal Year 1960*—Continued

Appropriation title	Amount
TRANSFERS FROM OTHER DEPARTMENTS—Con.	
Technical Cooperation, General, Executive (Transfer to Corps of Engineers, Civil), 1960.....	\$6, 990. 40
Defense Support, General, Executive (Transfer to Corps of Engineers, Civil), 1959.....	16, 367. 87
Construction and Rehabilitation, Bureau of Reclamation (Transfer to Corps of Engineers, Civil).....	33, 831. 45
Construction, Bureau of Sport Fisheries and Wildlife (Transfer to Corps of Engineers, Civil).....	414, 475. 97
Construction, Bureau of Indian Affairs (Transfer to Corps of Engineers, Civil).....	714, 466. 42
Passamaquoddy Tidal Power Survey (Transfer to Corps of Engineers, Civil).....	130, 440. 34
Salaries and Expenses, National Science Foundation (Transfer to Corps of Engineers, Civil).....	13, 519. 72
U.S. Dollar Advances From Foreign Governments, U.S. Educational Exchange Program, State (Transfer to Corps of Engineers, Civil).....	1, 890. 64
Capital Outlay, U.S. Soldiers' Home (Transfer to Corps of Engineers, Civil).....	741, 835. 12
Capital Outlay, U.S. Soldiers' Home (Transfer to Corps of Engineers, Civil), 1959 and 1960.....	75, 059. 17
Total Transfers from Other Departments.....	2, 247, 809. 49
WORKING FUNDS:	
Consolidated Working Fund, Army, Engineers, Civil (Trust Fund).....	962. 46
Grand total, all funds.....	887, 272, 364. 02

¹ Returned to Treasury.² Refund from Canadian Government.³ Returned to originating agency.

CHAPTER VI

OTHER CIVIL WORKS ACTIVITIES

1. ST. LAWRENCE SEAWAY

By letter dated September 17, 1954, addressed to the Secretary of the Army, the St. Lawrence Seaway Development Corporation designated the Corps of Engineers as its agent for design and construction of the seaway project. The Corporation was created on May 13, 1954, under authority of Public Law 358, 83d Congress, 2d session.

The project involves construction of navigation facilities in U.S. waters in the reach of the St. Lawrence River which constitutes the boundary between the United States and Canada, and coordination thereof with the power facilities to be constructed concurrently by others.

The major features of the project are complete except for channel dredging in the South Cornwall Island section. All completed features have been transferred to the St. Lawrence Seaway Development Corporation for operation. The contracting authority of the Corps of Engineers was terminated on December 31, 1958, and all cost and fiscal responsibilities were assumed by the Seaway Corporation on January 1, 1959.

For detailed report on the St. Lawrence Seaway, see volume 2, Buffalo District, page 1482.

2. ST. LAWRENCE RIVER JOINT BOARD OF ENGINEERS

This Board, having United States and Canadian Sections, was created pursuant to the order of approval issued by the International Joint Commission on October 29, 1952. The U.S. Section was established and its duties defined by Executive order issued November 4, 1953. Members of the U.S. Section are the Secretary of the Army and the Chairman of the Federal Power Commission, with Maj. Gen. C. G. Holle (retired) (retained on a consultant basis) and Mr. F. L. Adams, Chief of the Bureau of Power of the Federal Power Commission, as alternates.

The duties of the Board are to review and approve, in behalf of both Federal Governments, the plans, specifications, and work schedules for the power project in the International Rapids section of the St. Lawrence River, and to inspect construction operations to insure conformance with Board approvals. The power project is

being constructed jointly by the Power Authority of the State of New York and The Hydro-Electric Power Commission of Ontario. Supervision of construction pursuant to the Federal Power Commission license issued July 15, 1953, to the Power Authority of the State of New York also was assigned to the U.S. Section, thus integrating these two Federal supervisory activities.

A small engineering staff to support the U.S. Section was established in Massena, N.Y., on July 1, 1954, with Washington liaison. In consideration of the advanced stage of construction of the power project, the Massena office was closed on August 8, 1958, with staff support thereafter being provided in the Office of the Chief of Engineers and the Washington office of the Federal Power Commission.

Costs of the U.S. Section through June 30, 1960, totaled about \$435,000. An additional \$30,000 was appropriated to finance the activities of the U.S. Section during fiscal year 1961. All costs of the U.S. Section are subject to reimbursement by the Power Authority of the State of New York, as provided in the appropriation acts.

3. FLOOD-FIGHTING AND OTHER EMERGENCY OPERATIONS

Emergency flood-control activities, involving advance preparation for flood emergencies, flood rescue work, flood fighting, and the repair and restoration of flood control works damaged or destroyed by flood, were carried on during the year under statutory authority set forth in Public Law 99, 84th Congress, and prior legislation. The fiscal year expenditures from the emergency fund totaled \$5,431,633. The most noteworthy flood emergencies and emergency operations during the fiscal year are described in the following paragraphs.

Earthquake slide, Madison River, Mont. On August 17, 1959, one of the most severe earthquakes in the history of the United States struck the Rocky Mountain region in the vicinity of Yellowstone National Park. Nine persons are known to have died, and it is estimated that there were 18 additional deaths of persons whose bodies were not recovered. The earthquake, with magnitude of 7.5 to 7.75 on the Richter Scale, caused a massive rockslide which blocked the lower end of Madison Canyon, causing impoundment of the flow of Madison River at a point 95 miles above its mouth and 7 miles downstream from the Montana Power Co.'s Hebgen Dam. The slide formed a natural dam from 200 to 400 feet high and about three-fourths of a mile wide from upstream to downstream toes.

The earthquake caused major faulting near Hebgen Dam, which was damaged but not breached. The crest of the embankment dropped and the spillway and chute were irreparably damaged although operable. Continuing after shocks threatened further damage to the

structure, and loss of control from Hebgen Lake, which was nearly full. There was also danger that uncontrolled flow from Hebgen Reservoir into the new Earthquake Lake would back water to the toe of Hebgen Dam and further weaken the damaged structure. Possible instability of the slide dam, with Earthquake Lake filled to a maximum 200-foot depth, created another potential for downstream flooding.

At the request of the Governor, and to relieve the flood threat, the Corps of Engineers conducted flood emergency operations under the authority of Public Law 99. Since there was imminent danger that Hebgen Dam would fail, Hebgen Reservoir was drawn down as quickly as possible. While the level of Earthquake Lake was rising toward the crest of the slide dam, heavy construction equipment cut a 250-foot-wide spillway on the crest to enable safe passage of water over the slide. The slide spillway began to overflow on September 10; by October 26 the emergency spillway had been deepened and lowered 65 feet below the original slide crest, thus reducing the level of Earthquake Lake and its volume to safe conditions and eliminating the flood threat. Coordination during the operations was maintained with the Montana Power Co. and various Federal, State, and local agencies.

September–October 1959 floods in Texas and Oklahoma. Heavy rainfall during the period September 20 to October 6, 1959 caused widespread flooding in the Trinity, Brazos, Colorado, Guadalupe-San Antonio, and Nueces River Basins in Texas, and the Arkansas River Basin in Oklahoma. The Corps of Engineers under Public Law 99 provided flood-fighting assistance and accomplished emergency levee repairs. Under Public Law 875, 81st Congress, the President issued a "major disaster" declaration regarding the affected areas in Oklahoma. In Texas, of the estimated \$14,800,000 damages, about \$8,400,000 could have been prevented by Federal flood control projects either under construction or authorized. Additional damages estimated at \$24,200,000 were prevented by existing Federal flood control projects.

November 1959 floods in western Washington. Heavy rains combined with sudden snowmelt caused rivers on the western slope of the Cascade Mountains, and the Yakima River on the eastern slope, to rise to flood stages. The Green River reached a record flood stage at Auburn, Wash., on November 23 and the Snohomish River a near-record stage at Snohomish on November 24. Areas of extensive damage were concentrated primarily in the Snohomish and Green River Watersheds, designated by the Governor of the State of Washington as disaster areas. Levees were breached and overtopped; there was widespread damage to property and highways, railroads, bridges, and public utilities. Preliminary estimates of damage in the

Green and Snohomish River Watersheds were \$4.5 million and \$6 million, respectively. The Corps of Engineers provided flood-fighting assistance, and accomplished emergency repair and restoration of damaged levees, under the authority of Public Law 99. Restoration work in progress when another flood of lesser proportions occurred, on December 15, 1959, made it possible for local interests to hold the levee systems with the assistance of Corps flood-fighting efforts, and prevented recurrence of severe flood damages.

March 1960 flood in Florida. Heavy rainfall during March 1960 caused major flooding in central Florida, with damages estimated at over \$20 million. On March 23, the President under the authority of Public Law 875 issued a "major disaster" declaration regarding the affected area.

March-April 1960 floods in Missouri and Upper Mississippi River Basins. Rapid snowmelt of unusually heavy snow cover caused moderate to severe flooding throughout the Missouri River Basin. The flood affected many communities, disrupted highway and rail transportation, and covered vast farming areas. Total damages were estimated to exceed \$25 million. Damages prevented by existing Federal flood control works were estimated at about \$332 million. An extensive repair and restoration program of damaged levees was launched under Public Law 99 by the Corps of Engineers. The President made "major disaster" declarations under Public Law 875 for the affected areas in the following States: Nebraska, April 4, 1960; South Dakota, April 8, 1960; and Missouri, April 20, 1960.

Hawaiian seismic wave. Following South American earthquakes in May 1960, intense seismic waves struck Hawaii. Human and property losses were particularly severe in the islands of Hawaii, Maui and Oahu, where the wave caused widespread flooding. At Hilo, on the island of Hawaii, 33 persons were reported dead, 25 missing, and over 200 injured. The total property damages were estimated to be over \$52 million. The President under Public Law 875 made a "major disaster" declaration on May 25, 1960, with respect to the affected areas in Hawaii.

Arkansas floods, May 1960. Severe flooding in the State of Arkansas caused damages warranting a declaration by the President on May 28, 1960, of "major disaster," under authority of Public Law 875.

Flash flood, New York. Extremely heavy rainfall caused a flash flood on June 17, 1960, along the tributaries of the Susquehanna River in the vicinity of Endicott, Union, and Johnson City. The flood damaged portions of the Federal flood-control project under construction, and adjacent areas, with total damages estimated at

\$6,940,000. Emergency repair and restoration of damaged flood control works was initiated under Public Law 99 authority.

4. ADMINISTRATION OF LAWS FOR PROTECTION OF NAVIGABLE WATERS

In administering the Federal laws enacted for the protection and preservation of the navigable waters of the United States, 6,468 permits for structures or operations in navigable waters were issued, and plans for 131 bridges, dams, dikes, or causeways were approved during the year. In addition, 21 extensions of time for commencement or completion of construction of bridges were granted. Sixty-eight sets of regulations for the use, administration, and navigation of navigable waters were established, including drawbridge regulations, establishment of anchorage grounds, special anchorage areas, dumping grounds, danger zones, and restricted areas.

The Corps of Engineers engaged in the following additional activities relative to the administration of the laws for the protection of navigable waters: Investigations of the discharge or deposit of refuse matter of any kind in navigable waters; prevention of pollution of coastal navigable waters by oil; administrative determination of the heads of navigation and the extent to which the laws shall apply to specific streams; supervision of the harbors of New York, Hampton Roads, and Baltimore to prevent obstructive or injurious deposits in the waters thereof, including the waters of Long Island Sound; establishment of reasonable rates of toll for transit across bridges over navigable waters; granting of permits for the occupation and use of Federal works under control of the Corps of Engineers; reports of international boards on operations affecting international boundary waters; and legislation in connection with the foregoing.

There is a continuing program to prevent deposits or to obtain the removal of any deposits in channels which obstruct navigation or increase Federal maintenance costs. In all areas of the country, most industries and municipalities are removing, or are participating in the cost of removal of shoals for which they are responsible. All waterways are being observed and negotiations commenced with any company or municipality which may be causing shoaling due to waste deposits. During the past few years agreements averaging approximately \$1 million per year have been reached with some of our major industries. The program has resulted not only in a saving in dredging costs of approximately \$4 million and more efficient use of dredging equipment, but also in a stimulation of planning by the industries to improve their operations for recovering salvageable material. In the case of one company, which declined to accept responsibility for its deposits in the Calumet River, Ill., court action was instituted in 1954. Decree was entered on June 24, 1957, by the

district court in favor of the United States. The defendant was ordered to stop the deposit of materials and to remove the accumulation within 6 months. The defendant appealed the case and on January 22, 1959, the court of appeals reversed the district court. On June 1, 1959, the Supreme Court agreed to review the case, and on May 16, 1960, handed down a decision favorable to the United States.

A report entitled "Navigational Clearance Requirements for Highway and Railroad Bridges" prepared by the U.S. Department of Commerce was released in 1955. The conflicting interests involved are the desire of navigation interests for the maximum navigation opening and the desire of bridge owners to conserve funds by building a minimum crossing. In connection with its continuing studies of the problems involved at intersections of highway and water traffic, the Corps of Engineers is making a thorough review of its policy on bridge clearances with a view to resolving problems involved in meeting the requirements of both the water and land transportation interests. The present system of standard bridge clearances is being reviewed and extended to cover, insofar as practicable and necessary, all navigable waterways. During the fiscal year 1960, review of the standard bridge clearances for the Missouri River was continued and review was commenced on the Upper Mississippi River and the Sacramento River. One public hearing was held for the Mississippi River. The standard vertical bridge clearance for the Atlantic Intracoastal Waterway from Norfolk, Va., to Port Everglades, Fla., was determined to be 65 feet. For the Gulf Intracoastal Waterway from Apalachee Bay to Pensacola Bay, it was determined to be 50 feet, and from Pensacola Bay to Brownsville, Tex., 73 feet.

The procedure whereby a "findings of fact" is prepared for attachment to the formal approval of bridge plans was continued. When necessary or in controversial cases, an economic analysis to assist in determination of the clearance requirements for a bridge may be developed. Toward the end of fiscal year 1956, the Secretary of the Army gave his advance approval to the location and plans of bridges across reaches of waterways navigable in law but not actually navigated other than by logs, log rafts, rowboats, canoes, or small motorboats. Action has been implemented to set up a procedure for administering this advance approval and delineating these proposed reaches.

Under the Bridge Alteration Act (Truman-Hobbs) approved on June 21, 1940, as amended by the act of July 16, 1952, the cost of altering a bridge used for railroad traffic, combined railroad and highway traffic or a publicly owned highway bridge, found by the Secretary of the Army to be obstructive to navigation, is apportioned between

the bridge owner and the United States. Hearings in connection with obstructive qualities are held to determine if the bridge is an unreasonable obstruction to navigation. During fiscal year 1960, no hearings were held on obstructive bridges. Initial funds were made available for commencement of alteration of one bridge and additional funds have been made available for continuation on three bridges. Action was continued on six additional obstructive bridge cases in various stages of development.

The removal of wrecks in navigable waters of the United States is governed by sections 19 and 20 of the River and Harbor Act approved March 3, 1899, and is predicated entirely upon their being obstructions to navigation. During the fiscal year, 44 wrecks were removed by the Corps of Engineers as obstructions to navigation.

5. REGULATION OF HYDRAULIC MINING, CALIFORNIA

The California Debris Commission, created by act of Congress, regulates hydraulic mining in the drainage area of the Sacramento and San Joaquin Rivers to prevent the resulting debris from being carried into navigable waters. The Commission has licensed 13 mining operators, of which 2 utilize storage behind the Federal debris dams.

During the year the Harry L. Englebright Dam and the North Fork Dam, together with their appurtenant service facilities, were operated and maintained for the storage of hydraulic mining debris and improved recreational facilities were provided. Bank restoration and protection along the right and left banks of the Yuba River, in the vicinity of Rubke Bend, Dantoni Orchard, and Walnut Avenue, was accomplished.

6. CIVIL WORKS INVESTIGATION PROGRAM

A total of 82 studies and tests leading to development of more reliable engineering design data, utilization of superior or less costly construction materials, and improvements in construction and maintenance procedures for civil works projects were continued under the civil works investigation program, with 9 of these studies being completed during the year. Of the total program cost of \$1,174,566 for fiscal year 1960, approximately 71 percent was expended at the U.S. Army Engineer Waterways Experiment Station, principally in the fields of hydraulics, concrete and soils mechanics, and 6 percent by the Beach Erosion Board. The balance of the work was carried out by Corps field offices.

The nine investigations completed were—

CW 024—Mosquito control and experimental shoreline growth studies, and tree inundation mortality rate inventories at Clark Hill Reservoir.

CW 028—Development of mobile floating equipment for clearing partially filled flood control reservoir areas.

CW 179—Development of devices and methods to improve accuracy of gage well water level measurements at high dams.

CW 300—Model studies to determine forces and stresses in various types of miter gates (locks) under different operating conditions.

CW 510—Development of charts, tables, and procedures for design of pressure relief well systems.

CW 802—Determination of design characteristics and capacities of various types of large flared conduit entrances.

CW 817—Model and prototype tests to refine hydraulic design criteria for discharge lines at large-capacity pumping plants.

CW 855—Study of velocities in and sedimentation characteristics of coastal inlet entrances and channels.

CW 906—Development of a computer program for calculating temperatures in mass concrete structures.

In addition to these 9 projects, 14 substudies under other continuing investigations were completed during fiscal year 1960, and 40 interim reports were published presenting significant results for use by the Corps of Engineers prior to formal completion of various other civil works investigations.

A total of seven new investigational studies were initiated during the year, relating to (a) the in-place shear strength of rock foundations; (b) runoff characteristics of bottomland and hillside terrain; (c) comprehensive study of the hydrologic factors associated with the Great Lakes and their drainage system; (d) compilation of a uniform laboratory test manual for soils, (e) effect of particle size on triaxial tests of cohesive soils and of cohesionless soils; (f) development of compaction tests applicable to cohesionless materials; and (g) operating characteristics of emergency closure gates.

7. UNITED STATES LAKE SURVEY

The U.S. Lake Survey, under its authorized project, continued the program of preparing, revising, and distributing navigation charts of the Great Lakes and their outflow rivers, the New York Canal system, Lake Champlain, and the Minnesota-Ontario border lakes, and the study of all matters affecting the hydraulics and hydrology of the Great Lakes system. The Great Lakes Pilot and seven supplements thereto were compiled and issued to complement the navigation information on the charts.

Offshore sounding of Lake Erie was completed. Sweeping operations were conducted in the area of a reported striking of a vessel in the southerly approach to Grays Reef Passage in northeastern Lake Michigan, and over the wreck of the *Monrovia* in central Lake Huron.

Inshore soundings were conducted along the eastern end of Lake Ontario from Stony Point to Nine Mile Point, N.Y. The Lake Survey portion of the joint survey with the Canadian Hydrographic Service in Lake St. Lawrence was completed.

Revisory surveys were accomplished in certain of the harbors on Lakes Michigan, Winnebago, Huron, and Superior, and along the lower Fox River.

Maintenance of the vertical control network was accomplished. First-order levels on the Detroit River which were begun in fiscal year 1959 were completed and the line was extended along Lake St. Clair and the St. Clair River to Lakeport on Lake Huron. First-order levels to establish International Great Lakes Datum were run at Dunkirk, Cleveland, Toledo, St. Clair Flats, along the Saginaw River, and from Petoskey to Cheboygan, Mich., and 28 special water level gages were installed and maintained in selected harbors for verifying vertical control and furnishing information for crustal movement study.

In addition, lake and river level, hydraulic, hydrologic, and artificial factor data were collected, reduced, tabulated, and disseminated. Engineering and scientific analyses were made of these data for the benefit of navigation, Corps of Engineers activities and other public, commercial, and industrial interests. Consulting engineer services were furnished to Corps of Engineers organizations and to the various international commissions, boards, and committees concerned with the Great Lakes and their outflow rivers, including the St. Lawrence River. Data pertaining to Great Lakes hydraulics and hydrology which are published regularly by the U.S. Lake Survey include monthly bulletins of Great Lakes levels, a hydrograph of monthly mean levels of the individual Great Lakes, tabulations of precipitation on the lake basins; diversions of water into, between, and from the lakes; flows in the connecting rivers; and 6-month forecasts of lake levels.

8. WASHINGTON, D.C., WATER SUPPLY

With funds appropriated for the District of Columbia, the Corps of Engineers continued the operation, maintenance, repair, and protection of the water-supply facilities, known as the Washington Aqueduct, to provide an uninterrupted and adequate supply of purified water to the distribution systems of the District of Columbia and adjacent Maryland and Virginia areas as authorized by law. The maximum daily consumption provided by the existing facilities was 254 million gallons and the average daily consumption was 153 million gallons.

In order to meet the future demands for water, construction work continued on the long-range program. Construction of the Little Falls raw water pumping station is complete and in operation. The construction of the reinforced-concrete fishway through the new Little Falls diversion dam at Snake Island is complete and in operation. A contract for the construction of the new Dalecarlia filter and chemical buildings has been awarded.

For detailed report on Washington, D.C., water supply, see volume 2, "Washington, D.C., District," page 296.

9. FOREIGN TECHNICAL ASSISTANCE

The Corps of Engineers continued to participate in the foreign technical assistance program of the Department of State and the International Cooperation Administration. This participation has entailed the inservice training of selected engineers from foreign governments, the accommodation of visiting foreign nationals at civil works projects and activities, the design and procurement of dredging plant for foreign governments, and the provision of engineering information and literature relating to the development of water resources.

Training in flood control and harbor and power engineering was provided for selected engineers from the Governments of Argentina, Brazil, Chile, Egypt, Greece, India, Japan, Korea, Philippines, Taiwan, Turkey, and Vietnam.

The hopper dredge *Essayons* continued to dredge in the Suez Canal until September 13, 1959, under a lease agreement with the Suez Canal Authority. The *Essayons* removed a total of 10 million cubic yards of silt, clay, sand, and salt deposits from the Port Said Roadstead and Harbor at the Mediterranean end of the canal, the northern and southern anchorages in the Great Bitter Lake, and the main canal through the lake.

Work on the design and construction of a 16-inch pipeline dredge for Vietnam was initiated.

In addition, the Corps of Engineers received foreign government representatives and engineers from various free nations and afforded them the opportunity to visit the Corps' civil works offices and projects to observe construction organizations and techniques.

Upon request, engineering information pertaining to the Corps' civil works program was furnished to foreign engineers and government representatives.

10. PUBLICATIONS OF THE CORPS OF ENGINEERS

The following publications pertaining to civil works activities were issued during the fiscal year 1960.

A. Available at the Government Printing Office, Washington 25, D.C., at indicated price:

1. Port Series:

No. 19, Volume 2—Ports on the Gulf Coast of the United States: Freeport, Beaumont, Orange, Port Arthur, Brownsville, and Port Isabel, Tex.....	\$3. 00
No. 20, The Port of New Orleans, La.....	3. 25
No. 23, The Ports of Galveston and Texas City, Tex.....	1. 00

2. Transportation Series:

No. 3, Transportation Lines on the Great Lakes System, 1960.....	. 60
No. 4, Transportation Lines on the Mississippi River System and the Gulf Intracoastal Waterway, 1959.....	1. 75
No. 5, Transportation Lines on the Atlantic, Gulf, and Pacific Coasts, 1959.....	2. 50

3. Engineer Manuals:

EM 1110-2-1405, Flood-Hydrograph Analyses.....	. 40
EM 1110-2-1406, Runoff From Snowmelt.....	1. 75
EM 1110-2-1408, Routing of Floods through River Channels.....	. 75
EM 1110-2-1409, Backwater Curves in River Channels.....	. 55
EM 1110-2-2602, Planning and Design of Navigation Lock Walls and Appurtenances.....	1. 25
EM 1110-2-3103, Architectural Design of Pumping Stations.....	. 25

B. Available at place of publication at listed price or as indicated:

1. Great Lakes Pilot, 1960. U.S. Army Engineer District, Lake Survey, Detroit 26, Mich. (including supplements)..... 3. 25
2. Waterborne Commerce of the United States, calendar year 1959:
 - Part 1, Waterways and Harbors: Atlantic Coast. U.S. Army Engineer Division, New England, Waltham, Mass., or U.S. Army Engineer District, Lake Survey, Detroit 26, Mich..... 1. 30
 - Part 2, Waterways and Harbors: Gulf Coast, Mississippi River System and Antilles. U.S. Army Engineer Division, Lower Mississippi Valley, Vicksburg, Miss., or U.S. Army Engineer District, Lake Survey, Detroit 26, Mich..... 1. 20
 - Part 3, Waterways and Harbors: Great Lakes. U.S. Army Engineer District, Lake Survey, Detroit 26, Mich.. . 85
 - Part 4, Waterways and Harbors: Pacific Coast, Alaska, and Pacific Islands. U.S. Army Engineer District, San Francisco, San Francisco 19, Calif., or U.S. Army Engineer District, Lake Survey, Detroit 26, Mich.. . 1. 00
 - Part 5, National Summaries: U.S. Army Engineer District, Lake Survey, Detroit 26, Mich..... . 35
 - Supplement to Part 5—Domestic Inland Traffic, Areas of Origin and Destination of Principal Commodities. U.S. Army Engineer District, Lake Survey, Detroit 26, Mich.... . 35

Division addresses:

- U.S. Army Engineer Division, Lower Mississippi Valley, Post Office Box 80, Vicksburg, Miss.
- U.S. Army Engineer Division, Missouri River, Post Office Box 1216, Omaha, Nebr.
- U.S. Army Engineer Division, New England, 424 Trapelo Road, Waltham 54, Mass.
- U.S. Army Engineer Division, North Atlantic, 1216 Federal Office Building, 90 Church Street, New York 7, N.Y.
- U.S. Army Engineer Division, North Central, 536 South Clark Street, Chicago 5, Ill.
- U.S. Army Engineer Division, North Pacific, 210 Custom House, Portland 9, Oreg.
- U.S. Army Engineer Division, Ohio River, Post Office Box 1159, Cincinnati, Ohio.
- U.S. Army Engineer Division, Pacific Ocean, Building 96, Fort Armstrong, Honolulu 13, Hawaii.
- U.S. Army Engineer Division, South Atlantic, Post Office Box 1889, Atlanta, Ga.
- U.S. Army Engineer Division, South Pacific, Post Office Box 3339, Rincon Annex, San Francisco 19, Calif.
- U.S. Army Engineer Division, Southwestern, Santa Fe Building, 1114 Commerce Street, Dallas 2, Tex.

CHAPTER VII

ECONOMY MEASURES

ORGANIZATION, FACILITIES, AND PROCEDURES

Effective steps were taken during the year to increase efficiency and economy in the supervision and administration of the civil works program as well as in operational performance through improved organizations and procedures and by changes in working methods. Sound business management efforts have been intensified to provide an offsetting factor against higher price levels and increasingly complex water resource problems. Significant economies have been realized.

Organization. In April 1960 the Garrison, N. Dak., District office was reduced to the status of an area office under the Omaha, Nebr., District, with an estimated savings of approximately \$600,000 annually. Except for this reduction, sustained and increased workloads, both civil and military, require retention of all existing division and district organizations for the civil program. In the New England Division, action was initiated to transfer operation and ownership of the Division office to the General Services Administration at an estimated annual savings to the Corps of approximately \$600,000.

Floating and other plant operations. Constant review is maintained to find ways of improving the efficiency and utilization of existing plant to replace obsolete units and make increased use of available commercial facilities. In connection therewith, the following changes relating to major items of plant have been effected:

Repowering and installation of new dredge pumps in the pipeline dredge *Luckiamute* was completed. The new engines and pumps with increased power and efficiency replaced old, obsolete equipment, and it is expected that reduced maintenance and increased production will adequately justify the modifications made.

Initiated a program for repowering and installation of larger pumps on booster barge No. 2 in the Portland District. The increase from 20-inch to 24-inch pumps will provide the increased capability necessary to pump dredged materials greater distances to spoil areas.

The construction of the hopper dredge *Markham* has been completed and the dredge was commissioned at Cleveland, Ohio, May 17, 1960.

The construction of a new towboat to replace the 33-year-old paddle wheel steamer *Mississippi* was initiated.

The pipeline dredge *Gillespie* was declared excess and disposed of by public sale. The transfer of the operating machinery of the pipeline dredge *Chittenden* to the China National Government in Formosa and the disposal of the remaining hull and house by public sale was completed. The dipper dredge *St. Paul* was declared excess and disposal initiated.

Studies and investigations are continuing in connection with improving the design and increasing the operating efficiency of dredge pumps, dragheads, and distribution systems, and the testing and evaluation of commercially available radio waves which will permit accurate positioning of dredges and survey boats in fog or other inclement weather.

The following are examples of outstanding management improvements related to plant operations which are presently in effect and have been evaluated and reported this fiscal year:

In the painting of metal surfaces in damp, humid areas such as in the lower Mississippi Valley, considerable difficulty is encountered because of condensation. A procedure for enveloping the object to be painted in a temporary enclosure and then reducing the humidity in the enclosure by means of refrigeration to a temperature a few degrees less than the object to be painted eliminated the condensation and allowed painting to progress at a normal rate regardless of weather conditions. Although the full effects of the improvement cannot be evaluated, in the case of the hopper dredge *Langfitt* it allowed a good paint job to be obtained, reduced dockage costs, and returned the vessel to duty 6 days sooner than would otherwise have been possible. Estimated net savings in this case was \$27,000.

A great number of harbors in the Great Lakes have controlling depths which limit the draft of a vessel using that particular harbor or river. One of these, the Ontonagon Harbor, Wis., had a controlling depth of 10 feet, due mainly to a lack of maintenance over a period of 3 years. When it became necessary to open this harbor to deeper draft vessels in the shortest practicable time, the usual method of dredging with a shallow draft bucket dredge would have taken approximately 55 days, at a cost of \$1.172 per cubic yard. Normal hopper dredge operation was not feasible as the *Hains*, one of the smaller dredges, has a draft light of 9 feet 6 inches and a loaded draft of 12 feet 8 inches to 13 feet. To utilize a previously developed capability in the hopper dredge *Hains*, to discharge dredged material directly over the side, a 20-foot extension was connected to the discharge outlet. This permitted material to be side casted far enough over the side to prevent its sliding or drifting back into the

dredged area. This operation was continued until a pilot channel deep enough to allow conventional hopper dredging was developed. This improvement resulted in the contemplated dredging being accomplished in approximately 17 days at \$0.426 per cubic yard, a dollar saving of \$62,000.

Project operations. Improved methods and procedures have resulted in significant savings in project operations. For example, first-order aerial photogrammetric surveys are being conducted to obtain earthwork quantities for design estimates on relocations of highways and railroads required for the construction of John Day and Ice Harbor Dams on the Columbia and Snake Rivers. Estimated annual savings are \$250,000.

Another example is relief of ice pressure on lock gates by means of a portable bubbler system. This carries air to the bottom of the channel and ejects it at 10-foot intervals, creating a bubbling action which carries warm water from the bottom to melt the ice. The annual savings over cutting ice with hand or electric saws at the locks in the St. Paul District approximates \$36,000.

Supply. Saving achieved in civil supply operations during fiscal year 1960 amounted to approximately \$3 million as a result of utilization of excess personal property required from other agencies in lieu of resorting to new procurement from commercial sources. Of this amount, \$2,500,000 represented major items of plant and equipment.

CHAPTER VIII

WATERBORNE COMMERCE OF THE UNITED STATES

The waterborne commerce of the United States showed improvement during the calendar year 1959 with an overall gain of 4.8 percent in tonnage and 4.0 percent in ton-miles. Total freight aggregated 1,052.4 million tons, and 196.6 billion ton-miles were carried on the Nation's waterways as compared with the 1,004.5 million tons and 189.0 billion ton-miles in 1958.

Total domestic traffic amounted to 726.7 million tons in 1959 as compared with the 1958 total of 695.7 million tons; total foreign traffic was 325.7 million tons and 308.9 million tons for 1959 and 1958, respectively. Reflected in the foreign traffic is an increase in Great Lakes U.S. ports' trade with foreign countries overseas from 0.7 million tons in 1958 to 3.9 million tons in 1959, the first year of operation of the new St. Lawrence Seaway.

Imports from foreign countries lead the advances with an increase of 24.0 million tons, up 12.7 percent, to 213.5 million tons. Internal traffic at 282.3 million tons was 21.2 million tons higher than the previous year, and coastwise traffic rose from 194.1 million tons in 1958 to 205.5 million tons in 1959. Small portions of the gains in coastwise and internal traffic were accounted for by the reclassification of intraterritory traffic due to the granting of statehood to Alaska and Hawaii. Consequently, intraterritory traffic in 1959 was recorded as 1.0 million tons as compared with 2.8 million tons in 1958. Local and intraport traffics were slightly higher in 1959 than the previous year, with a combined gain of 1.3 percent. Declines of 6.0 percent and 0.8 percent were registered in exports to foreign countries and in the domestic Great Lakes trade, respectively.

The 196.6 billion ton-miles of freight carried on U.S. waterways in 1959 were comprised of 79.9 billion ton-miles on the Great Lakes System, 65.7 billion ton-miles on the Mississippi River System, and 51.0 billion ton-miles on the coastal and other waterways. The Great Lakes ton-miles were unchanged from 1958, while the Mississippi River System and the other waterways were 6.5 billion ton-miles and 1.1 billion ton-miles higher, respectively, than the previous year.

Total freight handled at ports and carried on the waterways improved by the Corps of Engineers under congressional authorization are presented in the following tabulations. Detailed data on the commodities handled, the vessel trips at the ports, and the individual waterways are contained in the publications listed in paragraph B2, section 10, of chapter VI.

TOTAL WATERBORNE COMMERCE OF THE UNITED STATES 1950-1959

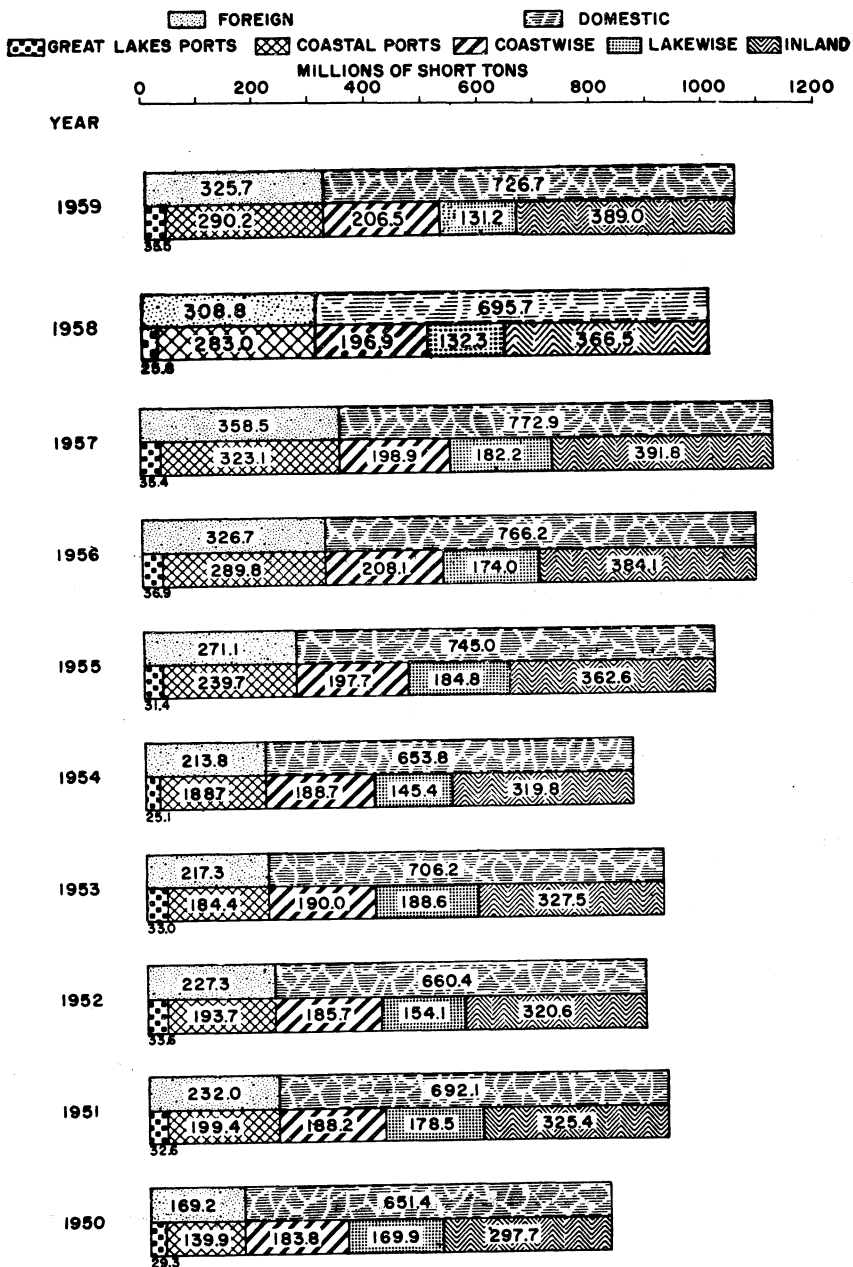


Chart VI

Table 23. Total Waterborne Commerce of the United States, Calendar Years 1949-59

[In millions of tons of 2,000 pounds]

Year	Total	Foreign						Domestic						
		Imports			Exports			Total	Coast-wise	Lake-wise	Internal	Intra-port	Local	Intrater-ritory
		Total	Coastal ports	Great Lakes ports	Total	Coastal ports	Great Lakes ports							
1949.....	740.7	82.0	77.2	4.8	83.4	65.7	17.6	575.4	161.4	145.6	165.7	48.3	54.3	(*)
1950.....	820.6	102.0	96.3	5.7	67.2	43.6	23.6	651.4	182.5	169.9	190.8	51.7	55.2	1.2
1951.....	924.1	108.7	101.8	6.9	123.3	97.6	25.7	692.1	186.8	178.5	213.4	51.0	61.1	1.4
1952.....	887.7	116.0	108.7	7.3	111.4	85.1	26.3	660.4	184.2	154.1	216.6	49.2	54.8	1.5
1953.....	923.5	128.0	120.6	7.4	89.4	63.8	25.6	706.2	188.8	188.6	225.0	47.9	54.7	1.3
1954.....	867.6	129.4	123.5	5.9	84.4	65.2	19.2	653.8	187.2	145.4	217.1	48.0	54.7	1.4
1955.....	1,016.1	153.0	144.3	8.7	118.1	95.4	22.7	745.0	195.7	184.8	249.7	52.9	60.0	2.0
1956.....	1,092.9	174.2	163.3	10.9	152.5	126.5	26.0	766.2	205.9	174.0	269.7	53.1	61.3	2.2
1957.....	1,131.4	186.4	176.2	10.1	172.2	146.9	25.3	772.9	196.4	182.2	281.1	50.2	60.6	2.4
1958.....	1,004.5	189.5	181.5	8.0	119.4	101.6	17.8	695.7	194.1	132.3	261.1	48.9	56.5	2.8
1959.....	1,052.4	213.5	198.6	14.9	112.2	91.6	20.6	726.7	205.5	131.2	282.3	49.7	57.1	1.0

*Included in other types of domestic traffic.

† Traffic within the States of Alaska and Hawaii transferred to other domestic traffic categories.

Note. Totals represent the sums of unrounded figures, hence they may vary slightly from the sums of the rounded amounts.

Authorization for the collection of these data is contained in various river-and-harbor acts enacted by Congress through the years, the principal authorization being section 11 of the River and Harbor Act of September 22, 1922. While the information as now collected and compiled is designed to meet the administrative requirements of the Corps of Engineers in connection with the prosecution of the navigation program as required by Congress, it also provides necessary and vital data for other governmental departments, commercial and shipping concerns, and others interested in transportation.

Table 24. Commerce at Project Harbors, Calendar Year 1959

[In tons of 2,000 pounds]

Harbor	Tons
<i>Other than Great Lakes</i>	
Bar Harbor, Maine.....	388
Belfast Harbor, Maine.....	1, 162
Boothbay Harbor, Maine.....	1, 770
Camden Harbor, Maine.....	102
Cape Porpoise Harbor, Maine.....	7, 441
Corea Harbor, Maine.....	350
Hendricks Harbor, Maine*.....	-----
Isle au Haut Thoroughfare, Maine.....	1, 061
New Harbor, Maine.....	871
Northeast Harbor, Maine*.....	-----
Portland Harbor, Maine.....	17, 363, 095
Rockland Harbor, Maine.....	100, 991
Rockport Harbor, Maine*.....	-----
Stonington Harbor, Maine.....	9, 576
Thomaston Harbor, Maine*.....	-----
Wood Island Harbor, Maine, and the Pool at Biddeford.....	125
York Harbor, Maine.....	700
Burlington Harbor, Vt.....	456, 906
Portsmouth Harbor, N.H.....	1, 315, 369
Beverly Harbor, Mass.....	185, 133
Boston, main waterfront, Massachusetts.....	6, 087, 737
Cohasset Harbor, Mass.....	201
Cuttyhunk Harbor, Mass.....	455
Duxbury Harbor, Mass.....	23
Edgartown Harbor, Mass.*.....	-----
Fall River Harbor, Mass.....	2, 174, 230
Gloucester Harbor, Mass.....	185, 093
Harbor of Refuge, Nantucket, Mass.....	31, 259
Hingham Harbor, Mass.*.....	-----
Lynn Harbor, Mass.....	663
Manchester Harbor, Mass.....	232
Marblehead Harbor, Mass.....	675
New Bedford and Fairhaven Harbor, Mass.....	262, 670
Newburyport Harbor, Mass.....	9

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Other than Great Lakes—Continued</i>	
Plymouth Harbor, Mass.....	7, 281
Pollock Rip Shoals, Nantucket Sound, Mass.*.....	
Port of Boston, Mass.....	20, 464, 817
Provincetown Harbor, Mass.....	13, 282
Rockport Harbor, Mass.....	125
Salem Harbor, Mass.....	1, 500, 292
Scituate Harbor, Mass.....	98
Vineyard Haven Harbor, Mass.....	49, 702
Wellfleet Harbor, Mass.....	705
Great Salt Pond, Block Island, R.I.....	289
Harbor of Refuge, Block Island, R.I.....	1, 560
Harbor of Refuge, Point Judith and Point Judith Pond, R.I.....	51, 956
Newport Harbor, R.I.....	124, 012
Providence River and Harbor, R.I.....	8, 273, 129
Wickford Harbor, R.I.*.....	
Branford Harbor, Conn.....	36
Bridgeport Harbor, Conn.....	2, 308, 029
Clinton Harbor, Conn.....	26
Duck Island Harbor, Conn.*.....	
Fivemile River Harbor, Conn.....	933
Greenwich Harbor, Conn.....	95, 281
Milford Harbor, Conn.....	737
New Haven Harbor, Conn.....	8, 257, 428
New London Harbor, Conn.....	1, 065, 804
Norwalk Harbor, Conn.....	322, 724
Southport Harbor, Conn.*.....	
Stamford Harbor, Conn.....	819, 872
Stonington Harbor, Conn.....	3, 388
Westport Harbor and Saugatuck River, Conn.....	8, 342
Echo Bay Harbor, N.Y.....	116, 180
Great Kills Harbor, Staten Island, N.Y.....	920
Greenport Harbor, N.Y.....	27, 868
Hay (West) Harbor, N.Y.*.....	
Hempstead Harbor, N.Y.....	5, 340, 114
Huntington Harbor, N.Y.....	648, 940
Lake Montauk Harbor, N.Y.....	1, 556
Mamaroneck Harbor, N. Y.....	97, 572
Mattituck Harbor, N.Y.....	58, 711
New Rochelle Harbor, N.Y.....	1, 416
Northport Harbor, N.Y.....	10, 362
Peekskill Harbor, N. Y.....	155, 133
Plattsburg, N.Y.....	503, 568
Port Chester Harbor, N.Y.....	845, 150
Port Henry Harbor, N.Y.....	8, 933

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Other than Great Lakes—Continued</i>	
Port Jefferson Harbor, N.Y.....	1, 493, 600
Port of New York, N.Y., and N.J.....	154, 155, 873
Roundout Harbor, N.Y.....	1, 185, 258
Sag Harbor, N.Y.....	21, 852
Saugerties Harbor, N.Y.*.....	
Tarrytown Harbor, N.Y.....	578, 953
Keyport Harbor, N.J.*.....	
Aliquippa-Rochester, Pa.....	5, 904, 315
Clairton-Elizabeth, Pa.....	8, 619, 934
Philadelphia Harbor, Pa.....	47, 656, 492
Pittsburgh, Pa.....	6, 872, 194
Wilmington Harbor, Del.....	2, 461, 541
Annapolis Harbor, Md.....	21, 649
Baltimore Harbor and Channels, Maryland.....	40, 223, 607
Black Walnut Harbor, Md.....	572
Breton Bay, Md.....	3, 154
Cambridge Harbor, Md.....	78, 829
Claiborne Harbor, Md.....	150
Crisfield Harbor, Md.....	45, 460
Lowes Wharf, Talbot County, Md.....	1, 426
Nanticoke River at Bivalve, Md.....	2, 176
Nanticoke River at Nanticoke, Md.....	5, 836
Ocean City Harbor and Inlet and Sinepuxent Bay, Md.....	7, 673
Queenstown Harbor, Md.....	252
Rock Hall Harbor, Md.....	5, 946
Tilghman Island Harbor, Md.....	6, 380
Washington Harbor, D.C.....	2, 266, 008
Cape Charles City Harbor, Va.....	2, 870
Horn Harbor, Va.....	10, 980
Monroe Bay and Creek, Va.....	3, 478
Norfolk Harbor, Va.....	34, 952, 961
Port of Newport News, Va.....	13, 807, 208
Portsmouth Harbor, Va., Channel to Nansemond Ordnance Depot*.....	
Port of Richmond, Va.....	2, 807, 291
Potomac River at Alexandria, Va.....	383, 334
Winter Harbor, Va.....	830
Beaufort Harbor, N.C.....	115, 147
Belhaven Harbor, N.C.....	20, 527
Edenton Harbor, N.C.....	36, 978
Manteo (Shallowbag) Bay, N.C.....	13, 118
Morehead City Harbor, N.C.....	574, 706
Port of Wilmington, N.C. (<i>see also</i> Wilmington Harbor, N.C., for waterway data).....	3, 490, 351
Silver Lake Harbor, N.C.....	2, 226

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Other than Great Lakes—Continued</i>	
Charleston Harbor, S.C.....	4, 632, 042
Georgetown Harbor (Winyah Bay), S.C.....	1, 041, 169
Port Royal Harbor, S.C.....	13, 286
Brunswick Harbor, Ga.....	542, 078
Darien Harbor, Ga.....	1, 955
Savannah Harbor, Ga.....	4, 175, 064
Apalachicola Bay, Fla.....	15, 519
Bayou Chico, Fla.....	198, 205
Canaveral Harbor, Fla.....	293, 864
Carrabelle Harbor, Fla.....	17, 488
Cedar Keys Harbor, Fla.....	868
Charlotte Harbor, Fla.....	1, 354, 550
Eau Gallie Harbor, Fla.*.....	
Fernandina Harbor, Fla.....	175, 813
Fort Pierce Harbor, Fla.....	158, 980
Jacksonville Harbor, Fla.....	7, 698, 212
Key West Harbor, Fla.....	161, 809
Melbourne Harbor, Fla.....	425
Miami Harbor, Fla.....	1, 882, 484
Palm Beach Harbor, Fla.....	870, 310
Panama City Harbor, Fla.....	1, 164, 252
Pensacola Harbor, Fla.....	934, 876
Port Everglades Harbor, Fla.....	5, 313, 810
Port St. Joe Harbor, Fla.....	1, 671, 425
St. Augustine Harbor, Fla.....	7, 321
St. Petersburg Harbor, Fla.....	581, 080
Tampa Harbor, Fla.....	13, 334, 688
Chickasaw Creek, Ala.....	758, 871
Guntersville, Ala.....	1, 127, 308
Mobile Harbor, Ala.....	20, 034, 297
Three Mile Creek, Ala.....	4, 715, 698
Baton Rouge, La.....	25, 672, 105
Lake Charles, La. (Calcasieu River and Pass, La.).....	18, 721, 126
New Orleans, La.....	50, 441, 941
Terrebonne Bay, La.*.....	
Biloxi Harbor, Miss.....	167, 521
Greenville, Miss.....	1, 380, 787
Gulfport Harbor, Miss.....	353, 747
Natchez, Miss.....	524, 131
Pascagoula Harbor, Miss.....	530, 065
Pass Christian Harbor, Miss.....	717
Vicksburg, Miss.....	881, 120
Aransas Pass, Tex.....	68, 683
Beaumont, Tex.....	26, 125, 522

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Other than Great Lakes—Continued</i>	
Brazos Island Harbor, Tex.....	1, 465, 770
Corpus Christi, Tex.....	18, 439, 688
Freeport Harbor, Tex.....	3, 948, 268
Galveston, Tex. (Galveston Channel, Tex.).....	6, 707, 618
Harbor Island, Tex.....	5, 705, 797
Houston, Tex. (Houston Ship Channel, Tex.).....	60, 265, 293
Orange, Tex.....	944, 281
Palacios, Tex.....	102, 273
Port Arthur, Tex.....	23, 095, 561
Port Bolivar, Tex.....	7, 468
Port Lavaca, Tex.....	1, 157, 281
Port Mansfield, Tex.....	18, 963
Rockport, Tex.....	4, 423
Sabine Pass Harbor, Tex.....	216, 509
Texas City, Tex. (Texas City Channel, Tex.).....	13, 649, 143
Victoria, Tex.....	349, 944
Helena, Ark.....	1, 970, 158
Chattanooga, Tenn.....	1, 510, 098
Knoxville, Tenn.....	815, 188
Memphis, Tenn.....	6, 338, 390
Nashville, Tenn.....	2, 557, 171
Kansas City, Mo.....	1, 249, 988
St. Louis, Mo.....	9, 254, 125
Cincinnati, Ohio.....	8, 630, 643
Louisville, Ky.....	7, 468, 424
Huntington, W.Va.....	14, 474, 411
Baudette Harbor, Minn.....	5
Minneapolis, Minn.....	849, 865
St. Paul, Minn.....	3, 592, 913
Mount Vernon, Ind.....	3, 812, 015
Bodega Bay, Calif.....	2, 613
Crescent City Harbor, Calif.....	349, 959
Humboldt Harbor and Bay, Calif.....	830, 436
Long Beach Harbor, Calif.....	, 537, 009
Los Angeles Harbor, Calif.....	19, 111, 909
Monterey Harbor, Calif.....	132, 063
Morro Bay Harbor, Calif.....	4, 090
Moss Landing Harbor, Calif.....	120, 902
Newport Bay Harbor, Calif.....	2, 698
Oakland Harbor, Calif.....	3, 588, 226
Redondo Beach (King Harbor), Calif.....	59
Redwood City Harbor, Calif.....	2, 667, 179
Richmond Harbor, Calif.....	15, 561, 224
San Diego Harbor, Calif.....	1, 720, 289
San Francisco Harbor, Calif.....	3, 619, 459

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Other than Great Lakes—Continued</i>	
Santa Barbara Harbor, Calif.....	1, 728
Stockton, Calif.....	2, 719, 825
Astoria, Oreg.....	372, 752
Coos Bay, Oreg.....	3, 214, 999
Depoe Bay, Oreg.....	129
Oregon Slough (North Portland Harbor), Oreg.....	320, 261
Portland, Oreg.....	13, 481, 664
St. Helens, Oreg.....	417, 793
Tillamook Bay and Bar, Oreg.....	37, 583
Yaquina Bay and Harbor, Oreg.....	500, 762
Anacortes Harbor, Wash.....	6, 948, 575
Bellingham Bay and Harbor, Wash.....	1, 582, 990
Blaine Harbor, Wash.....	14, 190
Everett Harbor, Wash.....	3, 091, 797
Grays Harbor and Chehalis River, Wash.....	2, 009, 557
Hammersley Inlet, Wash.....	1, 108, 413
Longview, Wash.....	2, 649, 161
Neah Bay, Wash.....	235, 285
Olympia Harbor, Wash.....	1, 356, 611
Port Angeles Harbor, Wash.....	2, 102, 629
Port Gamble Harbor, Wash.....	279, 348
Port Townsend Harbor, Wash.....	672, 521
Seattle Harbor, Wash.....	13, 066, 964
Tacoma Harbor, Wash.....	4, 677, 188
Vancouver, Wash.....	2, 015, 055
Willapa River and Harbor, and Naselle River, Wash.....	446, 465
Anchorage, Alaska.....	221, 387
Cordova Harbor, Alaska.....	22, 279
Craig Harbor, Alaska.....	1, 961
Elfin Cove, Alaska.....	127
Homer, Alaska.....	11, 809
Iliuliuk Harbor (Dutch Harbor), Alaska.....	152, 337
Juneau Harbor, Alaska.....	170, 312
Ketchikan Harbor, Alaska.....	1, 054, 907
Kodiak Harbor, Alaska.....	30, 566
Metlakatla Harbor, Alaska.....	6, 387
Myers Chuck Harbor, Alaska*.....	-----
Nome Harbor, Alaska.....	52, 916
Petersburg Harbor, Alaska.....	32, 716
Port Alexander, Alaska*.....	-----
Seldovia Harbor, Alaska.....	7, 258
Seward Harbor, Alaska.....	556, 124
Sitka Harbor, Alaska.....	144, 336
Skagway Harbor, Alaska.....	60, 271
Valdez Harbor, Alaska.....	42, 470

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Other than Great Lakes—Continued</i>	
Whittier Harbor, Alaska.....	118, 831
Wrangell Harbor, Alaska.....	169, 403
Hilo Harbor, Hawaii, Hawaii.....	905, 930
Honolulu Harbor, Oahu, Hawaii.....	4, 296, 855
Kahului Harbor, Maui, Hawaii.....	676, 386
Kaunakakai Harbor, Molokai, Hawaii.....	228, 805
Kawaihae Harbor, Hawaii.....	34, 694
Nawiliwili Harbor, Kauai, Hawaii.....	415, 724
Port Allen Harbor, Kauai, Hawaii.....	146, 021
Wake Island Harbor.....	144, 996
Arecibo Harbor, P.R.*.....	
Fajardo Harbor, P.R.....	299, 721
Guayanes Harbor, P.R.....	12, 335
Mayaguez Harbor, P.R.....	283, 441
Ponce Harbor, P.R.....	743, 138
San Juan Harbor, P.R.....	4, 569, 257
Christiansted Harbor, St. Croix, V.I.....	26, 954
St. Thomas Harbor, V.I.....	361, 585
<i>Great Lakes</i>	
Beaver Bay Harbor, Minn.....	59
Duluth-Superior Harbor, Minn. and Wis.....	31, 477, 365
Grand Marais Harbor, Minn.....	54, 294
Knife River Harbor, Minn.....	155
Lutsen Harbor, Minn.....	1
Two Harbors (Agate Bay), Minn.....	9, 079, 942
Warroad, Minn.....	1, 364
Zippel Bay, Minn.*.....	
Algoma Harbor, Wis.....	565
Ashland Harbor, Wis.....	1, 853, 437
Bayfield Harbor, Wis.....	2, 332
Cornucopia, Wis.....	551
Detroit Harbor, Wis.....	10, 875
Green Bay Harbor, Wis.....	3, 641, 182
Jackson Harbor, Wis.....	198
Kenosha Harbor, Wis.....	74, 229
Kewaunee Harbor, Wis.....	1, 143, 001
Manitowoc Harbor, Wis.....	2, 237, 576
Milwaukee Harbor, Wis.....	8, 799, 519
Oconto Harbor, Wis.....	47
Pensaukee Harbor, Wis.....	187
Port Washington Harbor, Wis.....	942, 322
Port Wing Harbor, Wis.....	312
Racine Harbor, Wis.....	118, 914

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Great Lakes—Continued</i>	
Sheboygan Harbor, Wis.....	502, 228
Two Rivers Harbor, Wis.....	188, 398
Algonac, Mich.....	1, 044
Alpena Harbor, Mich.....	2, 533, 186
Big Bay Harbor, Mich.....	5
Black River Harbor, Mich.....	34
Charlevoix Harbor, Mich.....	77, 976
Cheboygan Harbor, Mich.....	95, 272
Detour, Mich.....	244, 373
Drummond Island, Mich.....	2, 244, 493
Frankfort Harbor, Mich.....	1, 508, 612
Gladstone Harbor, Mich.....	261, 806
Grand Haven Harbor and Grand River, Mich.....	3, 390, 447
Grand Marais Harbor, Mich.....	74
Grand Traverse Bay Harbor, Mich.....	623
Harbor Beach, Mich., Harbor of Refuge.....	49, 481
Holland Harbor, Mich.....	254, 716
Isle Royale, Mich.*.....	-----
Lac La Belle Harbor, Mich.....	54
Leland Harbor, Mich.....	399
Lime Island, Mich.....	143, 711
Ludington Harbor, Mich.....	3, 838, 473
Mackinac Harbor, Mich.....	8, 578
Manistee Harbor, Mich.....	571, 569
Manistique Harbor, Mich.....	202, 394
Marine City, Mich.....	46, 604
Marquette Harbor, Mich.....	978, 266
Marysville, Mich.....	195, 271
Menominee Harbor, Mich.....	702, 450
Monroe Harbor, Mich.....	71, 945
Muskegon Harbor, Mich.....	4, 220, 392
Ontonogan Harbor, Mich.....	1, 438
Pentwater Harbor, Mich.....	25
Port Huron, Mich.....	674, 442
Port of Detroit, Mich.....	26, 116, 121
Port of Sault Ste. Marie, Mich.....	433, 798
Presque Isle Harbor, Mich.....	2, 792, 964
St. Clair, Mich.....	2, 338, 098
St. James Harbor (Beaver Island), Mich.....	1, 513
St. Joseph Harbor, Mich.....	435, 966
Saugatuck Harbor and Kalamazoo River, Mich.....	86
South Haven Harbor, Mich.....	114, 167
Traverse City Harbor, Mich.....	180, 831
Whitefish Point Harbor, Mich.....	2, 731

See footnote at end of table.

Table 24. Commerce at Project Harbors, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Harbor	Tons
<i>Great Lakes—Continued</i>	
White Lake Harbor, Mich.....	27, 152
Chicago Harbor, Ill.....	522, 224
Calumet Harbor and River, Ill. and Ind.....	21, 719, 604
Port of Chicago, Ill. and Ind.....	39, 923, 667
Waukegan Harbor, Ill.....	306, 673
Indiana Harbor, Ind.....	15, 706, 912
Michigan City Harbor, Ind.....	258, 442
Ashtabula Harbor, Ohio.....	9, 425, 890
Cleveland Harbor, Ohio.....	12, 537, 242
Conneaut Harbor, Ohio.....	5, 156, 359
Fairport Harbor, Ohio.....	2, 856, 689
Huron Harbor, Ohio.....	2, 054, 365
Lorain Harbor, Ohio.....	4, 673, 607
Port Clinton Harbor, Ohio.....	15, 667
Put In Bay, Ohio.....	6, 448
Sandusky Harbor, Ohio.....	6, 473, 116
Toledo Harbor, Ohio.....	33, 801, 912
Vermilion Harbor, Ohio.....	958
Erie Harbor, Pa.....	3, 909, 956
Barcelona, N.Y.....	32
Cape Vincent Harbor, N.Y.....	3
Dunkirk Harbor, N.Y.....	21, 985
Great Sodus Bay Harbor, N.Y.....	1, 007, 545
Niagara Falls, N.Y.....	17, 080
Ogdensburg Harbor, N.Y.....	425, 147
Oswego Harbor, N.Y.....	819, 274
Port of Buffalo, N.Y.....	15, 240, 355
Rochester (Charlotte) Harbor, N.Y.....	317, 343
Sackets Harbor, N.Y.....	68, 257
Tonawanda Harbor, N.Y.....	556, 971
Waddington Harbor, N.Y.....	68, 537
Wilson Harbor, N.Y.....	3

*No commerce reported.

Table 25. Commerce at Selected Areas, Calendar Year 1959

[In tons of 2,000 pounds]

Area	Tons
Delaware River and tributaries, Trenton, N.J., to the sea:	
Burlington-Florence-Roebling, N.J.	1, 238, 823
Camden-Gloucester, N.J.	3, 786, 963
Chester, Pa.	985, 481
Marcus Hook, Pa., and vicinity	18, 077, 337
New Castle, Del., and vicinity	11, 732, 882
Paulsboro, N.J., and vicinity	15, 796, 090
Penn Manor, Pa., and vicinity	6, 000, 648
Philadelphia Harbor, Pa.	47, 656, 492
Riverton-Delanco-Beverly, N.J.	1, 066, 540
Trenton Harbor, N.J.	389, 057
Wilmington Harbor, Del.	2, 461, 541
Other	1, 336, 467
Gross total	110, 528, 321
Net total	99, 926, 208
Hampton Roads, Va.:	
Channel from Phoebus, Va., to deepwater in Hampton Roads ..	2, 052
Hampton Creek, Va.	383, 552
Norfolk Harbor, Va.	34, 952, 961
Port of Newport News, Va.	13, 807, 208
Other	106, 687
Gross total	49, 252, 460
Net total	48, 817, 998
Corpus Christi Bay, Tex.:	
Corpus Christi, Tex.	18, 439, 688
Harbor Island, Tex.	5, 705, 797
Gross total	24, 145, 485
Net total	24, 112, 415

Table 25. Commerce at Selected Areas, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Area	Tons
San Francisco Bay, Calif.:	
Carquinez Strait, Calif.....	7, 220, 193
Oakland Harbor, Calif.....	3, 588, 226
Redwood City Harbor, Calif.....	2, 667, 179
Richmond Harbor, Calif.....	15, 561, 224
Sacramento River, Calif.....	1, 222, 266
San Joaquin River and tributaries, Calif.....	3, 679, 425
San Francisco Harbor, Calif.....	3, 619, 459
San Pablo Bay and Mare Island Strait, Calif.....	2, 471, 675
Suisun Bay Channel, Calif.....	3, 399, 835
Other.....	2, 172, 817
Gross total.....	45, 602, 299
Net total.....	38, 721, 632
Chicago, Ill. and Ind.:	
Buffington Harbor, Ind.....	1, 615, 936
Calumet Harbor and River, Ill. and Ind.....	21, 719, 604
Chicago Harbor, Ill.....	522, 224
Gary Harbor, Ind.....	6, 711, 826
Indiana Harbor, Ind.....	15, 706, 912
Lake Calumet, Ill.....	1, 385, 098
Other.....	18, 301, 934
Gross total.....	65, 963, 534
Net total.....	62, 673, 021

Table 26. Ton-Mileage of Freight Carried on the Inland Waterways of the United States, by System, Calendar Year 1959

System	Ton-miles
Atlantic coast waterways.....	29, 068, 019, 000
Gulf coast waterways.....	16, 565, 356, 000
Pacific coast waterways.....	5, 310, 502, 000
Mississippi River System, including Ohio River and tributaries.....	65, 721, 426, 000
Other waterways ¹	13, 436, 000
Great Lakes system ²	79, 880, 172, 000
Total.....	196, 558, 911, 000

¹ Includes Alaskan waterways.² Does not include traffic between foreign ports.

TON-MILES OF FREIGHT CARRIED ON THE WATERWAYS OF THE UNITED STATES, 1950-1959

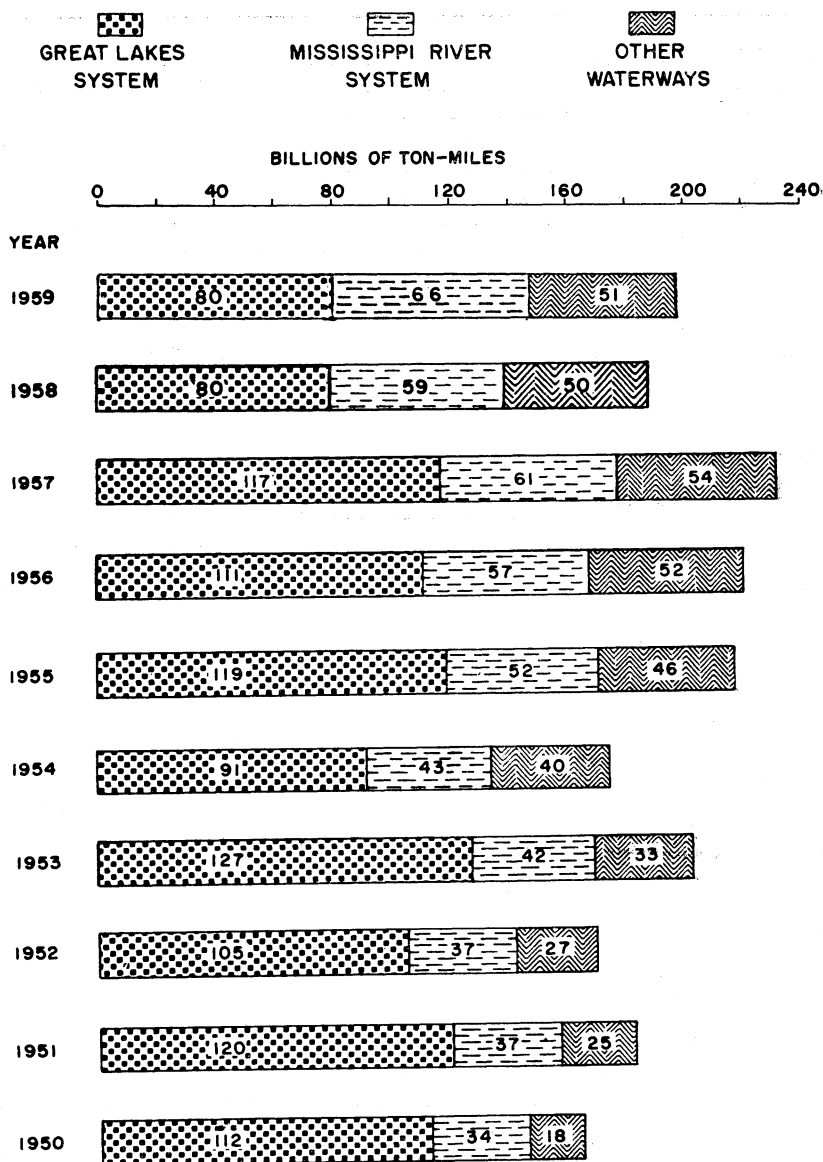


Chart VII

Table 27. Commerce on Project Waterways, Calendar Year 1959

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Josias River, Maine.....	94	(¹)
Kennebec River, Maine.....	139, 665	3, 529
Kennebunk River, Maine.....	14, 027	14
Lubec Channel, Maine.....	124, 966	224
Penobscot River, Maine.....	1, 296, 808	33, 393
Saco River, Maine.....	55	(¹)
St. Croix River, Maine.....	28, 723	453
Union River, Maine. ²		
Otter Creek, Vt. ²		
Annisquam River, Mass. ²		
Cape Cod Canal, Mass.....	12, 582, 549	220, 195
Chelsea River, Mass.....	6, 128, 237	9, 192
Dorchester Bay, Mass.....	32, 492	32
Fort Point Channel, Mass.....	318, 315	159
Ipswich River, Mass.....	362	1
Malden River, Mass.....	34, 873	35
Merrimack River, Mass. ²		
Mystic River, Mass.....	6, 121, 148	5, 684
Neponset River, Mass. ²		
Taunton River, Mass. ²		
Town River, Mass.....	855, 264	641
Weymouth Back River, Mass.....	37, 571	19
Weymouth Fore River, Mass.....	2, 226, 990	12, 375
Woods Hole Channel, Mass.....	45, 126	41
Pawcatuck River, R.I. and Conn.....	3, 175	21
Sakonnet River and Harbor, R.I. ²		
Seekonk River, R.I.....	228, 376	457
Warren River, R.I. ²		
Connecticut River above Hartford, Conn. ²		
Connecticut River below Hartford, Conn.....	2, 715, 972	124, 935
Housatonic River, Conn.....	1, 023, 606	5, 118
Mianus River and Cos Cob Harbor, Conn.....	29, 821	30
Mystic River, Conn.....	16	(¹)
Thames River, Conn.....	697, 527	11, 367
Bay Ridge and Red Hook Channels, N.Y.....	13, 017, 522	52, 070
Bronx River, N.Y.....	814, 685	1, 222
Browns Creek, N.Y.....	1, 040	1
Buttermilk Channel, N.Y.....	3, 572, 862	8, 218
Channel between Staten Island and Hoffman and Swinburne Islands, N.Y. ²		
Coney Island Channel, N.Y.....	5, 435, 088	7, 066
Coney Island Creek, N.Y.....	325, 615	326
East Chester Creek, N.Y.....	1, 925, 921	6, 741
East River, N.Y.....	52, 290, 628	418, 325
East Rockaway Inlet, N.Y.....	1, 190, 649	714

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Fire Island Inlet, N.Y.-----	243, 197	365
Flushing Bay, N.Y.-----	2, 643, 453	8, 459
Glen Cove Creek, N.Y.-----	271, 560	272
Gowanus Creek Channel, N.Y.-----	4, 842, 883	3, 874
Great South Bay, N.Y.-----	256, 092	4, 316
Harlem River, N.Y.-----	1, 780, 006	4, 904
Hudson River, N.Y. and N.J.:		
Deep Water in Upper Bay, N.Y., to Water-		
ford, N.Y. (net)-----	39, 592, 326	2, 030, 766
Mouth of Spuyten Duyvil Creek (Harlem		
River) to Waterford, N.Y.-----	20, 737, 243	1, 617, 549
Hudson River Channel, N.Y. and N.J.-----	36, 595, 265	413, 217
Jamaica Bay, N.Y.-----	5, 412, 481	64, 950
Jones Inlet, N.Y.-----	2, 253	5
Lemon Creek, Staten Island, N.Y.-----	1, 977	1
Long Island Intracoastal Waterway, N.Y.-----	2, 182	74
Lower Entrance Channels, New York Harbor,		
N.Y.-----	98, 269, 021	982, 690
Manhasset Bay, N.Y.-----	537, 696	753
Narrows of Lake Champlain, N.Y., and Vt.-----	1, 173, 911	15, 848
New York and New Jersey Channels, N.Y., and		
N.J.-----	106, 651, 651	2, 036, 380
New York State Barge Canal System, N.Y.-----	3, 719, 919	490, 722
Newtown Creek, N.Y.-----	8, 317, 024	24, 951
Niagara River, N.Y.-----	3, 982, 240	(³)
Orowoc Creek, N.Y.-----	2, 210	2
Patchogue River, N.Y.-----	231, 089	173
Peconic Bay and River, N.Y.-----	1, 647	2
Sheepshead Bay, N.Y.-----	56, 766	17
Upper Bay, N.Y. and N.J.-----	132, 335, 861	735, 602
Wallabout Channel, N.Y.-----	147, 798	30
Wappinger Creek, N.Y. ² -----		
Westchester Creek, N.Y.-----	1, 202, 819	2, 406
Absecon Creek, N.J.-----	64	(¹)
Absecon Inlet, N.J.-----	108, 617	217
Alloway Creek, N.J. ² -----		
Barnegat Inlet, N.J.-----	426	(¹)
Big Timber Creek, N.J.-----	148, 016	44
Cape May Canal, N.J. ² -----		
Cheesequake Creek, N.J. ² -----		
Cohansey River, N.J.-----	110, 521	2, 100
Cold Spring Inlet, N.J.-----	61, 004	61
Cooper River, N.J.-----	89, 181	89
Dennis Creek, N.J. ² -----		
Double Creek, N.J.-----	1	(¹)

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Elizabeth River, N.J.-----	1, 485	1
Goshen Creek, N.J. ² -----		
Hackensack River, N.J.-----	3, 757, 381	33, 816
Lemon Creek, N.J.-----	1, 977	1
Manasquan River, N.J.-----	42, 605	64
Mantua Creek, N.J.-----	250, 653	251
Matawan Creek, N.J. ² -----		
Maurice River, N.J.-----	4, 182	29
New Jersey Intracoastal Waterway-----	262, 648	1, 576
Newark Bay, N.J.-----	23, 274, 470	91, 404
Oldmans Creek, N.J. ² -----		
Passaic River, N.J.-----	9, 087, 616	68, 157
Raccoon Creek, N.J.-----	5, 040	45
Rahway River, N.J.-----	159, 822	368
Rancocas River, N.J. ² -----		
Raritan River, N.J.-----	10, 707, 871	50, 876
Raritan River to Arthur Kill Cut-Off Channel, N.J.-----	5, 521, 539	5, 522
Salem River, N.J.-----	41, 690	167
Sandy Hook Bay, N.J.-----	114, 905	27
Shark River, N.J. ² -----		
Shoal Harbor and Compton Creek, N.J.-----	55, 068	14
Shrewsbury River, N.J. ² -----		
Toms River, N.J.-----	5	(¹)
Tuckerton Creek, N.J.-----	761	2
Washington Canal and South River, N.J.-----	85, 698	291
Waycake Creek, N.J. ² -----		
Woodbridge Creek, N.J.-----	43, 614	6
Woodbury Creek, N.J. ² -----		
Chester River, Pa. ² -----		
Schuylkill River, Pa.-----	14, 330, 092	57, 320
Appoquinimink River, Del. ² -----		
Broad Creek River, Del.-----	6, 229	62
Broadkill River, Del. ² -----		
Delaware River:		
Trenton, N.J., to the sea (net)-----	103, 921, 534	8, 709, 386
At Camden, N.J.-----	1, 517, 948	(⁴)
Between Philadelphia, Pa., and Trenton, N.J.-----	12, 955, 632	181, 379
Harbor of Refuge, Delaware Bay, Del.-----	171, 635	257
Philadelphia, Pa., to the sea-----	102, 747, 070	8, 528, 007
Indian River Inlet and Bay, Del. ² -----		
Inland Waterway between Rehoboth Bay and Delaware Bay, Del.-----	20, 992	231
Inland Waterway from Delaware River to Chesapeake Bay, Del., and Md.—Chesapeake and Delaware Canal-----	8, 852, 142	407, 199

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Leipsic River, Del. ² -----		
Little River, Del.-----	9	(1)
Mispillion River, Del.-----	16, 325	196
Murderkill River, Del.-----	509	1
Nanticoke River (including Northwest Fork), Del. and Md.-----	280, 540	10, 904
St. Jones River, Del. ² -----		
Smyrna River, Del. ² -----		
Waterway from Indian River Inlet to Rehoboth Bay, Del.-----	1, 200	1
Back Creek (Anne Arundel County), Md.-----	1, 120	(1)
Broad Creek, Somerset County, Md.-----	6, 777	22
Broadwater Creek, Md. ² -----		
Cadle Creek, Md. ² -----		
Channel to Island Creek, St. George Island, Md.-----	142	(1)
Chester River, Md.-----	52, 292	1, 242
Chincoteague Bay, Md. and Va.-----	26, 757	80
Choptank River, Md.-----	116, 370	1, 725
Corsica River, Md. ² -----		
Duck Point Cove, Md.-----	1, 799	2
Elk and Little Elk Rivers, Md.-----	28	1
Fishing Bay Tributaries, Dorchester County, Md.-----	5, 455	5
Fishing Creek, Calvert County, Md.-----	19	(1)
Governors Run, Md.-----	358	(1)
Hellens Creek, Md.-----	153	(1)
Herring Bay and Rockhold Creek, Md.-----	68	(1)
Herring Creek, Md.-----	636	1
Honga River and Tar Bay, Md.-----	6, 346	25
Knapps Narrows, Md.-----	6, 944	11
Lake Ogleton, Md. ² -----		
La Trappe River, Md.-----	6, 581	23
Little Creek, Queen Annes County, Md.-----	4, 225	1
Lower Thoroughfare at or near Wenona, Deal Is- land, Md.-----	1, 183	1
Manokin River, Md.-----	227	1
Middle River and Dark Head Creek, Md.-----	132	(1)
Mill Creek, Md.-----	121	(1)
Neale Sound, Md.-----	471	1
Northeast River, Md.-----	675	3
Parish Creek, Md.-----	3, 819	3
Patuxent River, Md.-----	127, 598	921
Pocomoke River, Md.-----	55, 775	1, 673
Rhodes Point to Tylerton, Somerset County, Md.-----	220	(1)
St. Catherines Sound, Md.-----	1, 391	2
St. Jerome Creek, Md.-----	885	2
St. Patricks Creek, Md.-----	1, 303	1

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Slaughter Creek, Md.....	475	(1)
Smith Creek, Md.....	5, 087	8
Susquehanna River above and below Havre de Grace, Md.....	18, 037	90
Town Creek, Md.....	2, 660	1
Tred Avon River, Md.....	86, 901	869
Twitch Cove and Big Thoroughfare River, Md....	5, 643	28
Tyaskin Creek, Md.....	8	(1)
Upper Thoroughfare, Deal Island, Md.....	10, 420	6
Warwick River, Md.....	14, 759	22
Wicomico River, Md. (Eastern Shore).....	452, 287	13, 441
Anacostia River, D.C.....	1, 441, 250	2, 883
Potomac River below Washington, D.C.....	3, 862, 793	284, 718
Potomac River, Virginia Channel.....	824, 618	3, 876
Potomac River, Washington Channel, D.C.....	140	(1)
Appomattox River, Va. ²		
Aquia Creek, Va.....	150	(1)
Atlantic Intracoastal Waterway between Norfolk, Va., and the St. Johns River, Fla. (net).....	3, 515, 600	772, 558
U.S. Army Engineer District, Norfolk:		
Via Dismal Swamp Canal Route.....	56, 944	1, 571
Via Great Bridge Lock Route.....	1, 067, 716	29, 042
U.S. Army Engineer District, Wilmington....	2, 188, 655	397, 197
U.S. Army Engineer District, Charleston....	1, 619, 819	210, 576
U.S. Army Engineer District, Savannah.....	1, 241, 636	118, 067
U.S. Army Engineer District, Jacksonville....	894, 282	15, 400
Blackwater River, Va.....	77, 677	1, 049
Bransons Cove, Va.....	1, 704	(1)
Broad Creek, Va.....	2, 224	1
Carter Creek, Va.....	40, 849	52
Channel connecting York River, Va., with Back Creek to Slaughter's Wharf.....	12, 160	12
Channel from Phoebus, Va., to deep water in Hampton Roads.....	2, 052	2
Channel to Newport News, Va.....	17, 389, 200	56, 515
Coan River, Va.....	8, 665	17
Cockrell Creek, Va.....	225, 416	338
Cranes Creek, Va.....	189	(1)
Davis Creek, Va.....	17, 646	9
Deep Creek, Accomac County, Va.....	2, 982	1
Deep Creek, Warwick County, Va.....	5, 821	12
Dymers Creek, Va.....	54, 191	54
Hampton Creek, Va.....	383, 552	1, 074
Hoskins Creek, Va.....	313	(1)
Hull Creek, Va.....	299	1
Jackson Creek, Va.....	276	(1)

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
James River, Va.....	5, 414, 811	341, 133
Kings Creek, Northhampton County, Va.....	20, 085	20
Little Machipongo River, Va.....	32, 050	64
Little River (Creek), Va.....	68, 112	68
Little Wicomico River, Va.....	5, 423	11
Locklies Creek, Va.....	14, 883	22
Lower Machodoc Creek, Va.....	5, 226	8
Mattaponi River, Va.....	58, 312	1, 182
Milford Haven, Va.....	3, 721	4
Mill Creek, Va.....	55	(1)
Mulberry Creek, Va.....	3, 092	2
Nandua Creek, Va.....	1, 560	6
Nansemond River, Va.....	458, 700	3, 807
Newport News Creek, Va.....	201, 246	80
Nomini Bay and Creek, Va.....	7, 141	21
Ocohanock Creek, Va.....	2, 502	10
Occoquan Creek, Va.....	31	(1)
Onancock River, Va.....	37, 478	206
Oyster Channel, Va.....	23, 719	21
Pagan River, Va.....	29, 429	118
Pamunkey River, Va.....	249, 760	375
Parrotts Creek, Va.....	6, 974	5
Quinby Creek, Va.....	6, 148	5
Rappahannock River, Va.....	433, 880	33, 635
Starlings Creek, Va.....	21, 885	13
Tangier Channel, Va.....	2, 234	3
Totuskey Creek, Va.....	34, 124	188
Upper Machodoc Creek, Va.....	140	(1)
Urbanna Creek, Va.....	9, 006	5
Waterway on the coast of Virginia.....	98, 748	2, 261
Whittings Creek, Va.....	123	(1)
Willoughby Channel, Va. ²		
York River, Va.....	4, 817, 315	110, 798
Bay River, N.C.....	1, 191	14
Black River, N.C. ²		
Cape Fear River, N.C., above Wilmington.....	451, 149	33, 159
Cashie River, N.C.....	16, 675	342
Channel connecting Thoroughfare Bay with Cedar Bay, N.C.....	1, 155	5
Channel from Back Sound to Lookout Bight, N.C.....	859	3
Channel from Pamlico Sound to Avon, N.C.....	812	1
Channel from Pamlico Sound to Rodanthe, N.C.....	35	(1)
Chowan River, N.C.....	121, 076	4, 588
Contentnea Creek, N.C. ²		
Drum Inlet, N.C. ²		
Far Creek, N.C.....	14, 031	28

See footnotes at end of table.

94 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Knobbs Creek, N.C.-----	3, 704	2
Lockwoods Folly River, N.C.-----	74	(1)
Mackay Creek, N.C.-----	113	(1)
Meherrin River, N.C.-----	7, 383	78
Neuse River, N.C.-----	142, 145	1, 421
Northeast (Cape Fear) River, N.C.-----	2, 569	64
Pamlico and Tar Rivers, N.C.-----	58, 874	824
Perquimans River, N.C.-----	23, 395	257
Roanoke River, N.C.-----	463, 059	9, 479
Rollinson Channel, N.C.-----	6, 182	19
Scuppernong River, N.C.-----	4, 433	22
Shallotte River, N.C.-----	1, 418	1
Smiths Creek (Pamlico County), N.C.-----	797	1
Smiths Creek (Wilmington), N.C.-----	4, 151	4
South River, N.C.-----	5, 590	17
Stumpy Point Bay, N.C.-----	1, 234	2
Swift Creek, N.C. ² -----		
Trent River, N.C.-----	6, 235	9
Waccamaw River, N.C. and S.C.-----	17, 595	730
Wallace Channel, Pamlico Sound, N.C.-----	5, 590	39
Waterway connecting Pamlico Sound and Beau- fort Harbor, N.C.-----	8, 840	159
Waterway connecting Swan Quarter Bay with Deep Bay, N.C.-----	1, 090	3
Wilmington Harbor, N.C. (<i>see also</i> Port of Wilmington, N.C., for port data)-----	4, 368, 465	102, 000
Abbapoola Creek, S.C. ² -----		
Ashley River, S.C.-----	12, 558	75
Beresford Creek, S.C. ² -----		
Congaree River, S.C. ² -----		
Great Pee Dee River, S.C.-----	20, 465	205
Mingo Creek, S.C. ² -----		
Russell Creek, S.C. ² -----		
Santee River, S.C.-----	4, 870	375
Shipyard River, S.C.-----	874, 059	874
Altamaha River, Ga.-----	38, 916	233
Apalachicola, Chattahoochee and Flint Rivers, Ga. and Fla.-----	386, 856	27, 943
Fancy Bluff Creek, Ga. ² -----		
Ocmulgee River, Ga. ² -----		
Oconee River, Ga. ² -----		
St. Marys River, Ga. and Fla.-----	91, 218	547
Satilla River, Ga.-----	46, 182	1, 478
Savannah River below Augusta, Ga.-----	77, 208	15, 133
Anclote River, Fla.-----	1, 868	16
Bayou Chico, Fla.-----	198, 205	207

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Blackwater River, Fla. ² -----	-----	-----
Channel from Naples, Fla., to Big Marco Pass, Fla.-----	26, 211	314
Choctawhatchee River, Fla. and Ala. ² -----	-----	-----
Courtenay Channel, Fla. ² -----	-----	-----
Crystal River, Fla.-----	330	3
East Pass Channel from the Gulf of Mexico into Choctawhatchee Bay, Fla.-----	470	1
Escambia and Conecuh Rivers, Fla. and Ala., Escambia Bay, Fla.-----	303, 419	6, 454
Gulf County Canal, Fla.-----	6, 652	34
Gulf Intracoastal Waterway between Apalachee Bay, Fla., and the Mexican border.-----	51, 305, 641	8, 128, 879
Homosassa River, Fla.-----	456	3
Horseshoe Cove, Fla.-----	1, 279	2
Hudson River, Fla. ² -----	-----	-----
Intracoastal Waterway, Caloosahatchee River to Anclote River, Fla.-----	239, 211	6, 162
Intracoastal Waterway:		
Jacksonville to Miami, Fla.-----	1, 026, 292	52, 273
Miami to Key West, Fla.-----	415, 141	5, 443
Kissimmee River, Fla.-----	141	1
La Grange Bayou, Fla.-----	76, 482	306
Lake Crescent and Dunns Creek, Fla.-----	65	(¹)
Little Manatee River, Fla.-----	495	2
Manatee River, Fla.-----	28, 749	66
Miami River Fla.-----	753, 163	2, 563
New River, Fla.-----	2, 242	14
Okeechobee Waterway, Fla.-----	283, 818	6, 504
Oklawaha River, Fla.-----	4, 757	19
Ozona, Fla., channel and turning basin.-----	866	1
Palm Beach, Fla., side channel and basin ² -----	-----	-----
Pithlachascotee River, Fla. ² -----	-----	-----
Rice Creek, Fla.-----	108, 396	358
St. Johns River, Fla., Jacksonville to Lake Harney.-----	1, 126, 468	52, 136
St. Lucie Inlet, Fla.-----	19	(¹)
St. Marks River, Fla.-----	449, 131	3, 104
Steinhatchee River, Fla.-----	558	3
Suwannee River, Fla.-----	465	2
Upper Chipola River, Fla., from mouth to Mari- anna ² -----	-----	-----
Watson Bayou, Fla.-----	121, 891	167
Withlacoochee River, Fla.-----	100, 335	967
Alabama-Coosa Rivers, Ala. and Ga.-----	661, 487	43, 083
Bayou Coden, Ala.-----	2, 947	2
Bayou La Batre, Ala.-----	22, 827	58

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Black Warrior, Warrior, and Tombigbee Rivers, Ala.....	5, 756, 227	1, 493, 959
Chickasaw Creek, Ala.....	758, 871	1, 025
Three Mile Creek, Ala.....	4, 715, 698	1, 513
Waterway connecting the Tombigbee and Ten- nessee Rivers, Ala. and Miss. ²		
Amite River and Bayou Manchac, La.....	15, 699	453
Atchafalaya River, La.....	6, 466, 704	729, 387
Atchafalaya River, La., Morgan City to Gulf of Mexico.....	2, 820, 861	79, 111
Barataria Bay, La.....	1, 554, 146	42, 021
Bayou Bartholomew, La. and Ark. ²		
Bayou Bonfouca, La.....	18, 875	170
Bayou Dupre, La.....	2, 902	17
Bayou Grossetete, La.....	34, 596	396
Bayou Lacombe, La.....	61, 912	293
Bayou Lafourche, La.....	2, 276, 384	31, 720
Bayou Little Caillou, La.....	38, 743	562
Bayou Plaquemine Brule, La.....	45, 255	543
Bayou Queue de Tortue, La. ²		
Bayou Segnette, La.....	1, 916	15
Bayou Teche, La.....	544, 664	22, 646
Bayou Terrebonne, La.....	1, 393, 293	12, 387
Bayou Vermilion, La.....	642, 739	7, 519
Bayous D'Arbonne and Corney, La. ²		
Bayous La Loutre, St. Malo, and Yscloskey, La.....	27, 573	440
Big Pigeon and Little Pigeon Bayous, La.....	190, 327	2, 525
Boeuf River, La. ²		
Calcasieu River and Pass, La.....	18, 721, 126	396, 636
Chefuncte and Bogue Falia Rivers, La.....	44, 461	96
Cypress Bayou and Waterway between Jefferson, Tex., and Shreveport, La.....	385	3
Franklin Canal, La.....	3, 574	18
Grand Bayou Pass, La. ²		
Gulf Intracoastal Waterway, Plaquemine to Mor- gan City Route, La.....	3, 122, 412	136, 520
Inland Waterway from Franklin to Mermentau River, La.....	452, 828	9, 028
Innerharbor Navigation Canal, La.....	6, 064, 308	20, 864
Johnsons Bayou, La.....	12, 460	62
Lake Charles Deep Water Channel, La.....	18, 448, 110	459, 358
Little River, La. ²		
Mermentau River, Bayou Nezpique and Bayou Des Cannes, La.....	2, 971, 344	86, 876
Pass Manchac, La.....	64, 978	455
Petit Anse, Tigre and Carlin Bayous, La.....	805, 319	6, 784

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Tensas River and Bayou Macon, La. ² -----	-----	-----
Terrebonne Bay, La. ² -----	-----	-----
Tickfaw, Natalbany, Ponchatoula, and Blood Rivers, La.-----	10, 253	123
Vinton Waterway, La.-----	59, 112	591
Waterway from Empire, La., to Gulf of Mexico--	430, 712	2, 956
Waterway from Intracoastal Waterway to Bayou Dulac, La. (Bayous Le Carpe and Grand Caillou)-----	396, 233	4, 909
Waterway from White Lake to Pecan Island, La.--	48, 982	88
Bayou Bernard, Miss-----	28, 626	121
Bayou Galere, Miss. ² -----	-----	-----
Big Sunflower River, Miss-----	1, 600	30
Bluff Creek, Miss-----	4, 807	38
East Pearl River, Miss-----	63, 230	869
Little Sunflower River, Miss. ² -----	-----	-----
Mississippi River:		
Minneapolis, Minn., to mouth of Passes (net)-----	120, 277, 984	37, 294, 213
Minneapolis, Minn., to mouth of Missouri River-----	25, 901, 449	4, 674, 204
Mouth of Missouri River to mouth of Ohio River-----	29, 327, 697	4, 348, 917
Mouth of Ohio River to but not including Baton Rouge, La.-----	39, 141, 710	19, 149, 973
Baton Rouge, La., to but not including New Orleans, La.-----	47, 779, 749	4, 152, 321
New Orleans, La., to mouth of Passes-----	71, 248, 739	4, 968, 798
Mouth of Yazoo River, Miss-----	422, 730	903
Pascagoula River, Miss-----	6, 850	240
Pearl River, Miss. and La.-----	127, 724	4, 467
Steele and Washington Bayous and Lake Wash- ington, Miss. ² -----	-----	-----
Tallahatchie and Coldwater Rivers, Miss. ² -----	-----	-----
Wolf and Jordan Rivers, Miss-----	28, 117	312
Yazoo River, Miss-----	76, 921	676
Anahuac Channel, Tex-----	1, 282, 052	6, 154
Bastrop Bayou, Tex. ² -----	-----	-----
Brazos Island Harbor, Tex. (Waterway)-----	1, 465, 770	16, 746
Cedar Bayou, Tex-----	338, 822	1, 768
Channel from Pass Cavallo to Port Lavaca, Tex.--	1, 157, 281	20, 385
Channel to Aransas Pass, Tex-----	68, 683	334
Channel to Palacios, Tex-----	102, 273	1, 418
Channel to Port Bolivar, Tex-----	7, 468	8
Channel to Rockport, Tex-----	4, 423	10
Chocolate Bayou, Tex-----	134, 360	2, 056
Clear Creek, Tex-----	10, 972	30

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Dickinson Bayou, Tex.....	397, 803	3, 878
Double Bayou, Tex.....	149, 923	333
Guadalupe River to Victoria, Tex.....	349, 944	3, 285
Port Aransas (Aransas Pass)—Corpus Christi Waterway, Tex.....	24, 112, 415	432, 101
Port Mansfield, Tex. (tributary).....	18, 963	27
Sabine-Neches Waterway, Tex.....	62, 447, 262	1, 418, 612
San Bernard River, Tex.....	964, 366	23, 311
Tributary Arroyo Colorado, Tex.....	206, 575	4, 973
Trinity River, Channel to Liberty, Tex.....	1, 225, 372	12, 622
Arkansas River, Ark. and Okla.....	760, 533	6, 124
Black River, Ark. and Mo. ²		
Ouachita and Black Rivers, Ark. and La.....	370, 040	66, 087
Ouachita River above Camden, Ark. ²		
Red River below Fulton, Ark.....	238, 992	6, 582
St. Francis and L'Anguille Rivers and Blackfish Bayou, Ark.....	1, 175	49
Saline River, Ark. ²		
Upper White River, Ark.....	41, 400	207
White River, Ark., below Batesville, Ark.....	305, 627	11, 178
Cumberland River, mouth to Burnside, Ky. (net).....	2, 898, 372	405, 344
Mouth to Nashville, Tenn.....	2, 898, 372	404, 987
Nashville, Tenn., to Burnside, Ky.....	13, 965	357
French Broad and Little Pigeon Rivers, Tenn.....	43, 210	293
Tennessee River, Tenn., Ala. and Ky.....	12, 036, 947	2, 164, 015
Wolf River, Tenn.....	848, 764	1, 458
Missouri River:		
Fort Benton to the mouth (net).....	6, 716, 291	397, 201
Kansas City to the mouth.....	3, 955, 166	327, 397
Omaha to Kansas City.....	2, 015, 376	61, 694
Sioux City to Omaha.....	1, 031, 454	7, 605
Fort Benton to Sioux City.....	134, 069	505
Muskingum River, Ohio.....	34, 716	7
Ohio River, Pittsburgh to mouth.....	80, 801, 017	17, 685, 302
Big Sandy River, Tug and Levisa Forks, Ky. and W. Va.....	123, 540	494
Green and Barren Rivers, Ky.....	5, 170, 118	448, 520
Kentucky River, Ky.....	398, 177	29, 131
Rough River, Ky. ²		
Tradewater River, Ky.....	101, 821	305
Kanawha River, W. Va.....	9, 714, 037	549, 346
Little Kanawha River, W. Va.....	224, 040	607
Allegheny River, Pa., improved portion.....	4, 034, 026	60, 074
Allegheny River, Pa., open channel portion.....	114, 600	115
Monongahela River, Pa. and W. Va.....	27, 174, 033	1, 349, 900
Youghiogheny River, Pa.....	112, 984	23

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Minnesota River, Minn.-----	1, 280, 213	15, 553
Big Suamico River, Wis.-----	152	(3)
Black River, Wis.-----	335, 608	286
Fox River, Wis.-----	58, 998	1, 180
St. Croix River, Wis. and Minn.-----	34, 306	786
Sturgeon Bay and Lake Michigan Ship Canal, Wis.-----	996, 036	(3)
Channels in Lake St. Clair, Mich.-----	78, 105, 468	(5)
Clinton River, Mich. ² -----		
Detroit River, Mich.-----	92, 618, 415	2, 512, 321
Grand River, Mich.-----	1, 713, 841	25, 708
Grays Reef Passage, Mich.-----	5, 899, 891	(3)
Keeweenaw Waterway, Mich.-----	413, 808	(3)
Rouge River, Mich.-----	11, 989, 408	(3)
Saginaw River, Mich.-----	5, 291, 346	(3)
St. Clair River, Mich.-----	78, 859, 216	4, 421, 053
St. Joseph River, Mich.-----	25, 515	179
St. Marys Falls Canal, Mich. (American Canal)-----	69, 644, 878	(3)
St. Marys River, Mich.-----	74, 791, 222	3, 928, 094
Calumet-Sag Channel, Ill.-----	5, 510, 830	117, 755
Chicago River (Main and North Branch), Ill.-----	3, 452, 589	6, 160
Chicago River (South Branch), Ill.-----	5, 531, 086	18, 424
Chicago Sanitary and Ship Canal, Ill.-----	20, 025, 175	367, 265
Illinois and Mississippi Canal, Ill. ² -----		
Illinois River, Ill.-----	22, 116, 641	4, 491, 996
Lake Calumet, Ill.-----	1, 385, 098	(3)
Middle River and connecting channels, California.-----	16, 846	102
Mokelumne River, Calif.-----	501	4
Napa River, Calif.-----	23, 203	360
Noyo River, Calif.-----	4, 318	5
Old River, Calif.-----	27, 533	703
Petaluma River, Calif.-----	125, 988	2, 457
Sacramento River, Calif.-----	1, 222, 266	72, 264
San Joaquin River, Calif.-----	3, 679, 425	122, 662
San Pablo Bay and Mare Island Strait, Calif.-----	16, 611, 973	(3)
San Rafael Creek, Calif.-----	13, 741	48
Suisun Bay Channel, Calif.-----	7, 883, 834	65, 396
Suisun Channel, Calif.-----	64, 549	839
Canals and Locks at Willamette Falls, Oreg.-----	1, 087, 865	326
Clatskanie River, Oreg.-----	11, 896	42
Columbia River:		
Mouth to International Boundary (net)-----	19, 524, 746	1, 634, 389
At Baker Bay, Wash.-----	2, 325	12
Columbia and Lower Willamette Rivers below Vancouver, Wash., and Portland, Oreg.-----	20, 630, 693	1, 376, 531

See footnotes at end of table.

100 REPORT OF THE CHIEF OF ENGINEERS, U.S. ARMY, 1960

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Columbia River—Continued		
At Bonneville, Oreg.-----	2, 043, 494	2, 043
At McNary Lock and Dam, Oreg. and Wash.-----	1, 063, 758	851
Between Wenatchee and Kettle Falls, Wash.-----	231, 182	7, 084
Vancouver, Wash., to The Dalles, Oreg.-----	3, 757, 586	170, 642
The Dalles Dam, Oreg. and Wash.-----	1, 504, 119	196
Columbia River and tributaries above The Dalles Dam to McNary Lock and Dam, Oreg. and Wash.-----	1, 516, 988	138, 656
Columbia River and tributaries above McNary Lock and Dam to Kennewick, Wash.-----	1, 074, 646	42, 800
Columbia Slough, Oreg.-----	42, 966	236
Coos and Millicoma Rivers, Oreg.-----	750, 374	3, 377
Coquille River, Oreg.-----	425, 004	4, 038
Coquille River, Oreg. (entrance)-----	311, 120	344
Multnomah Channel, Oreg.-----	811, 769	4, 871
Nehalem Bay, Oreg. ² -----		
Rogue River, Oreg.-----	26	1
Siuslaw River, Oreg.-----	295, 555	2, 069
Skipanon Channel, Oreg.-----	140, 328	261
Smith River, Oreg.-----	302, 342	1, 814
Snake River, Oreg., Wash. and Idaho-----	507, 021	855
Umpqua River, Oreg.-----	1, 016, 420	11, 181
Westport Slough, Oreg.-----	9, 019	6
Willamette River above Portland and Yamhill River, Oreg.-----	3, 723, 645	51, 527
Yaquina River, Oreg.-----	576, 060	5, 185
Youngs Bay and Youngs River, Oreg.-----	964, 477	3, 376
Kootenai River, Idaho and Montana ² -----		
Flathead Lake, Montana ² -----		
Chinook Channel, Wash.-----	201	(¹)
Cowlitz River, Wash.-----	131, 180	548
Deep River, Wash.-----	378, 049	1, 890
Elokomin Slough, Wash.-----	203, 609	204
Grays River, Wash.-----	11, 250	56
Hoquiam River, Wash.-----	633, 994	5, 072
Lake River, Wash.-----	14, 193	37
Lake Washington Ship Canal, Wash.-----	1, 941, 782	(³)
Lewis River, Wash.-----	87, 219	567
Quillayute River, Wash.-----	764	1
Skagit River, Wash.-----	85, 944	945
Skamokawa Creek, Wash.-----	18, 750	6
Skamokawa Steamboat Slough, Wash.-----	12, 823	3
Stillaguamish River, Wash.-----	4, 067	24

See footnotes at end of table.

Table 27. Commerce on Project Waterways, Calendar Year 1959—Continued

[In tons of 2,000 pounds]

Waterway	Tons	Total ton-miles (000 omitted)
Swinomish Slough, Wash.-----	450, 604	3, 181
Waterway connecting Port Townsend and Oak Bay, Wash.-----	483, 045	435
Gastineau Channel, Alaska ² -----		
Wrangell Narrows, Alaska-----	216, 924	4, 751

¹ Less than 500 ton-miles.² No commerce reported.³ Ton-miles not reported.⁴ Included in Delaware River, Philadelphia, Pa., to the sea.⁵ Included in St. Clair River.

O